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Canadian Atlantic Fisheries Scientific Advisory Committee

CAFSAC Research Document 85/78

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Comité scientifique consultatif des pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 85/78

Assessment of the 1984 4WX herring fishery

by

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ABSTRACT

The gear composition and timing of the 1984 herring fishery in NAFO Division 4WX was similar to that in previous years. The major portion of the fishery took place off southwest Nova Scotia (June-October; purse seine and gillnet) with smaller concentrations of effort off southern New Brunswick (June-February; weir and purse seine) and off Cape Breton (November-February; purse seine).

The 1984 fishery continued to be influenced strongly by markets and was marked by an exceptionally large roe market utilizing spawning fish and some directed effort for young fish by the southwest Nova Scotia purse seine segment. Reported landings declined slightly in 1984; mostly as a result of continued poor catches in the New Brunswick weir fishery.

The incidence of misreporting of landings is known to have been high, particularly in the purse seine segment of this fishery and corrections were made to the nominal catch matrix for the years 1973-1984 to give an "adjusted" matrix. The 1984 catch adjusted for misreporting (136,000 t) is higher than the comparable figure for 1983.

Cohort analysis was undertaken for both the nominal and adjusted catch matrices, calibrated (as in previous years) with larval abundance from the annual autumn larval herring survey. Analysis indicated an increase in stock biomass over recent years.

RÉSUMÉ

L'équipement et les périodes de pêche au hareng en 1984 dans la Division 4WX de l'OPANO ont été semblables à ceux des années précédentes. La pêche a été surtout pratiquée au large de la côte sud-ouest de la Nouvelle-Ecosse (juin-octobre : senne coulissante et filet maillant) avec une moindre concentration d'efforts au large de la côte sud du Nouveau-Brunswick (juin-février : bordigue et senne coulissante) et au large du Cap-Breton (novembre-février : senne coulissante).

La pêche de 1984 a continué à être très influencée par les marchés; elle a été marquée par un marché exceptionnellement important de la rogue de poissons en frai et par un effort particulier de pêche de jeunes poissons à la senne coulissante au sud-ouest de la Nouvelle-Ecosse. Les débarquements déclarés ont décliné légèrement en 1984, principalement à cause des faibles prises à la bordigue au Nouveau-Brunswick.

On sait que le nombre des débarquements non déclarés a été élevé, particulièrement pour la pêche à la senne coulissante, et la matrice des prises nominales pour les années 1973-1984 a été "ajustée". Les prises ajustées en 1984 (136 000 t), pour tenir compte des non déclarées, sont supérieures à celles de 1983.

Les matrices des prises nominales et des prises ajustées ont été soumises à une analyse de cohortes, avec étalonnage (comme les années précédentes) en fonction de l'abondance larvaire, telle qu'établie dans le relevé annuel d'automne des larves de hareng. D'après l'analyse, la biomasse globale a augmenté par rapport aux années précédentes.

INTRODUCTION

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Description of the Fishery

The 1984 herring fishery in NAFO Div. 4WX was similar to that in previous years. Purse seine was the major gear type, followed in relative importance by weirs, gillnet, traps, shutoffs and midwater trawl (Table 1). The major portion of the fishery took place off southwest Nova Scotia (4Xa; June-October) with smaller concentrations of effort off southern New Brunswick (4Xb; June-February) and off Cape Breton (4W Chedabucto Bay; November-February) (Fig. 1, 2).

The fishery continued to be influenced strongly by markets (Table 2) and the year was marked by an exceptionally large roe market utilizing spawning fish and some directed effort for young fish by the 4Xa purse seine segment.

1984 Management Plan

The Scotia-Fundy Region 1984 Herring Management Plan (Appendix 1) established a TAC for the 4WX stock of 80,000 t. This was allocated in the traditional manner between purse seine (80%) and inshore gear (20%), and among temporal components of the fishery (winter 4W, summer 4X, etc.). As in previous years, the N.B. weir and shutoff fishery and a portion (50%) of the fall 4X purse seine fishery (around Grand Manan) were considered to be on non-stock fish (i.e. from the Gulf of Maine stock), and therefore not included in the quota.

Catch Statistics

Reported landings for the 1984 fishery (DFO, Scotia-Fundy Region, Statistics Branch records) are listed by month and gear segment in Table 3. Long-term trends in landings by the major gear segments are shown in Table 4 and Fig. 3. Misreporting is known to have been high in the purse seine sections of the fishery and those values must be questioned (see section on misreporting; p. 6). Recorded landings for the stock totalled 78,083 t, a slight decrease from the previous 3 years.

Trends in reported stock (attributable to 4WX) and total (nominal) landings and in TAC are as follows:

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Reported stock catch (t)	122.7	149.7	143.9	115.2	117.1	95.9	59.0	79.6	87.7	84.7	84.4	78.1
Reported total catch (t)	142.6	170.3	174.7	143.9	150.7	134.7	96.2	93.1	106.8	110.7	94.1	88.7
TAC	-	-	-	-	109.0	110.0	99.0[1]	65.0[2]	100.0	80.2	82.0	80.0

[1] $F_{0.1}$ yield estimated at 60.0 t
[2] TAC raised from 60.0 t to 65.0 t in mid-season.

4Wa (Chedabucto Bay, Winter) Purse Seine Fishery

According to the 1984 Management Plan, this fishery was open from November 7, 1983 to March 16, 1984, with a quota of 16,000 t. The reported catch of 6336 t was considerably lower than the quota and extends a trend of declining catch apparent since 1981. Several factors contributed to the decline in landings, including:

- limited markets
- individuals saving quota for the summer fishery
- distribution of fish (inside the Chedabucto Bay closure line)
- misreporting

The decline was apparently not the result of lack of fish; an acoustic survey of the area (Buerkle 1985) showed a very large and persistent group of fish in the area.

4Xb (Bay of Fundy) Fall and Winter Purse Seine Fishery

The Bay of Fundy "fall" and "brit" fishery was open from October 16, 1983 to April 15, 1984. A total of 6000 t was assigned in two segments: 4000 t before December 31 and 2000 t for the traditional "brit" fishery after January 1. Only 50% of the landings were applied to the quota. The amount recorded was 5683 t, a substantial increase over 1983 (2157 t) but still much lower than the annual landings (10,000-40,000 t) between 1965 and 1975 (Fig. 3).

4Xa (Southwest Nova Scotia) Summer Fishery

The major segment of the fishery was hampered early in the season by a lack of market for large fish and low prices, but was assisted by an "over-the-side sales" program (vessels from the USSR) and by an exceptional roe market.

a) Purse seine

The 1984 Management Plan limited this fishery to the period June 1 to October 15, 1984 with a quota of 64,000 t minus what had been taken in the 4W and 4X fall and winter fisheries. Nominal landings of 58,343 t were recorded, a slight decrease from reported landings of the previous 2 years.

b) Gillnet

The gillnet segment of this fishery took only 4490 t, lower than recent years (since 1980) but at a level consistent with catches between 1964 and 1974. The major reason for the decrease over recent years was a lack of market.

c) Weirs

Nova Scotia weirs recorded 2684 t, a substantial increase in catch over 1983. Some of the increase may have been due to favorable market conditions caused by the decline in N.B. weir catches.

4Xb (New Brunswick) Weir and Shutoff Fishery

The New Brunswick weir and shutoff fishery suffered its lowest catch on record (8698 t). This represents the second consecutive year of record low landings and indicates a serious resource problem in this portion of the fishery.

Logbook Information

Purse seine log records were received from 26 vessels (60% of the fleet). These accounted for 36% of the recorded successful nights (= trips) and 43% of the recorded catch in the 4Xa fishery, and for 22% and 49% of the landings in 4Xb and 4Wa, respectively (Table 5).

ASSESSMENT INPUT DATA

Stock Components

As in previous assessments (e.g. Sinclair and Iles 1981), the 4WX fishery is divided into "stock" and "non-stock" components (Table 3). "Stock" fish are considered to belong primarily to the major SW Nova Scotia spawning groups, but this unit also encompasses smaller local stocks (e.g. Grand Manan, Scotts Bay). The "non-stock" component is comprised of:

- 4Xb (N.B.) weirs, 4Xb (N.B.) shutoffs - considered to be migrants from the 5Y stocks
- 4Xa miscellaneous - small localized Nova Scotia South Shore stocks caught in 4Xm gill, 4Xm trap and bycatches in handline and longline fisheries
- 4W miscellaneous - 4W fish taken in gear other than purse seine, on the assumption that the fish are from local stocks.

Also, as in previous assessments, those segments of the fishery which span the winter months (4Wa and 4Xb purse seine) are considered on a quota year basis (October 16, 1983-October 15, 1984). All other segments are considered for the calendar year 1984.

Biological Sampling

As in previous years, sampling of commercial catches was stratified by area, gear segment and month following the guidelines of:

1) obtaining as many length frequencies from individual catches as possible; and

2) stratified "detail" samples (two fish per half cm size-class above 24 cm; one per half cm size-class below 24 cm) to a level of at least 200 fish per area, gear and month.

Although sample coverage was high and resulted in 1181 length frequencies and 10,331 fish analyzed in detail (including ages), some cells (area and gear by month) were undersampled (Table 6).

Biological samples were matched to landings by gear component on a monthly basis as in previous assessments. Numbers at age from commercial catches were generated using programs HERNLW02 and HERNAG09 on the St. Andrews HP3000 in the traditional manner. For all gear components except 4Xa purse seine, length-frequency samples were applied on a monthly basis.

Since the summer purse seine fishery involves several distinct fishing grounds and markets, including directed effort for small (sardine) and large (roe) fish, a smaller spatial scale was considered necessary. As in the previous assessment, length frequencies were matched by individual 10' square and month. Catches were partitioned by square on the basis of logbook information and where samples and catches did not coincide, length-frequency information from adjacent squares was used. The difference that can occur between nearby areas is demonstrated in adjacent squares in the Trinity Ledge/McDormand Patch area (Table 7). This area was the focus for directed effort on both large spawning herring for the roe market (Trinity Ledge spawning grounds) and for small herring suitable for the sardine market (McDormand Patch). Estimates of numbers at age were obtained using the same age composition and assuming a standard catch, but using length frequencies from each square, and demonstrate the significant difference, especially in young and old fish (Table 7). The effect of calculating catch at age for an entire area as opposed to the sum of calculations for individual squares of the 4Xa purse seine fishery is shown in Table 8. While the overall total monthly numbers work out to be similar, there is considerable discrepancy in numbers of younger and older age-classes.

Age Composition

The age composition of the nominal catch in major gear segments of the fishery is presented in Table 9 and Fig. 4. Age 3 (1981 year-class) dominated the 4WX stock by number and age 4 (1980 year-class) dominated by weight. Age 2 fish dominated the 4WX non-stock (primarily 4Xb) fishery both in number and weight.

Misreporting

Misreporting by the 4WX purse seine fleet was significant. The situation is summarized in the following excerpt from the report of the Scotia-Fundy Herring Advisory Committee Working Group (Oct. 16, 1984):

> *"The working group found:*
>
> *a) The present T.A.C. and resultant boat quotas are so low as to make it difficult if not impossible for all seiners to survive in the fishery. This is recognized in the efforts being made by DFO to reduce the size of the fleet.*

b) The present system of monitoring and enforcing the herring management plan has been inadequate and it is generally recognized by all parties that the quotas are being exceeded on a regular basis.

The result of a) and b) above is that fishermen have every incentive to misreport, processors have good reason to take part in this process in order to maintain good relations with fishermen and ensure they get a fair share of the stocks, and there are no penalties of any significance to either of these groups to act as a deterrant to this misreporting.

Scientific advice on the fisheries is jeopardized because of the consistently unrepresentative catch figures being provided."

That working group contained representatives of most segments of the fishery (including purse seine groups), and stated formally what has now become a well known fact in this fishery: that nominal catch statistics for the 4WX purse seine fisheries are low compared to actual removals.

At the previous assessment meeting (CAFSAC Res. Doc. 84/72, Iles et al. 1984) two catch matrices were prepared, the first containing the "nominal" landings (i.e. those provided by Statistics Branch), and the second the "adjusted catch," which attempted to account for misreporting by purse seine fisheries over the period 1980-83. Estimates of the degree of underreporting in the previous assesment were as follows:

1980	1981	1982	1983
40%	30%	20%	30%

Estimates for 1985, derived from a variety of sources, indicate a purse seine catch of approximately 120,000 t, 1.7 times the reported purse seine landings of 70,373 t.

On the basis of extensive interviews with members of the fishing industry, as well as comparison between observer information and recorded landing statistics for 1983 and 1984, Mace (1985) estimated total removals by the purse seine fishery during the period 1973-1984. These estimates of purse seine landings (weight) are higher than recorded annual landings by the following factors:

1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1.35	1.30	1.35	1.20	1.15	1.15	1.20	1.45	1.55	1.55	1.63	1.77

Abundance Indices

a) CPUE

Catch-per-unit effort (calculated as in previous assessments - Table 10) decreased in 4Wa purse seine, 4X gillnet and 4Xb (N.B.) weir fisheries but increased considerably in the 4Xa purse seine and 4Xa (NS) weir

fisheries. None of these abundance indices is sufficiently reliable nor appropriate for use as independent checks on population estimates; purse seine indices are known to be inaccurate, N.B. weirs take non-stock fish, gillnet and N.S. weir landings were strongly influenced by market.

b) Larval abundance indices

The 1984 November larval survey was completed successfully (202 sets). Larval abundance (Table 11), as represented by the geometric mean, was higher than it has been since 1975.

Herring are demersal spawners and estimates of total egg deposition are impracticable. Larvae, on the other hand, tend to be persistent in their distribution, occupying "retention areas" (Iles and Sinclair 1982) that can be relatively easily covered by a survey grid. Larval abundance estimates are of two kinds, the first designed to cover the whole spawning area and spawning period by a series of surveys designed to integrate total larval production to a relatively early stage, usually up to a larval length of 10 mm (e.g. ICES Herring Working Group). The second is designed to cover the whole area of distribution of larvae at a time subsequent to the end of hatching but close enough to the mean time of spawning to minimize the variability in survival rate after hatching. Both methods assume constant hatching rates from deposited spawn.

The Bay of Fundy larval survey is of the second type for both historical and logistical reasons, and it is carried out as far as practical over the same time period (early November) each year. The survey generates an estimate of total larval abundance derived from counts of herring larvae of all lengths and from all stations. The implied assumptions are that mean spawning time is the same each year and that mortality rates are constant after hatching and until the mean time of the survey.

Three aspects of the precision and reliability of the larval abundance index have been considered:

1. Station redundancy. The larval abundance index has been estimated for a subset of stations from a completed survey, selected at levels of 40%, 60% and 80% to be compared with that for all stations (100% coverage) (R. N. O'Boyle and T. D. Iles, unpubl. data). The survey was found to be very robust and there was a significant increase in the coefficient of variation of the VPA/larval estimate ratio for the 1970's only when sampling density was reduced by a factor of 4 or so. This is to be expected as the station density of the Bay of Fundy survey (1 station/50 km^2) is about four times as great as the station density for larval surveys carried out in the Georges Bank area, the North Sea and the Pacific, to generate abundance indices for herring and other clupeid species.

2. Comparison of right and left Bongo net catches at the same station and using the same (505) mesh size. This tests the reproducibility of results under identical survey conditions and tests the consistency of methodological factors such as net washing and transfer to specimen jars, sorting in the laboratory and identification and separation of herring larvae.

Three cruises were examined and the results for two of these (P217, P268) were subjected to formal analysis (Table 12). Differences in numbers of larvae/m^3 for the whole survey area were about 2% for cruise 268 and 4% for P.217, both well within the precision of counting as laid down in the sorting guidelines. The third cruise (P298) was used to compare the counts from right and left sides of the Bongo net on an individual station basis and over a wide range of larval numbers. The variation at individual stations was about 20% for low larval counts but declined to below 10% for higher counts and to 5% or less for the stations at which the highest concentrations occurred.

3. Station repetition. A station with high abundance was sampled six times over a 10-h period (Table 13). The variation associated with the mean of 2323 was relatively small (SD = 500; SE = 224).

The survey sampling procedures appear to give final results well within the limits of current survey technology and of theoretical constraints of larval survey methods.

c) Acoustic estimate

Buerkle (1985) undertook an acoustic survey of a large overwintering aggregation of herring in Chedabucto Bay, N.S., during February 1984. The herring formed three coherent aggregations, the largest about 6 mi x 2 mi in area and between 15 and 50 m depth. The biomass of the largest aggregation was calculated to lie within the range 170,000-490,000 t (depending upon the target strength used) and the total biomass of herring in the bay was estimated to be about 545,000 t (Buerkle 1985).

ASSESSMENT PARAMETERS

A) Weights at Age

In recent 4WX assessments, long-term (1969-78) mean July weights at age have been used. In the last assessment these mean values were used for every year of the matrix:

	'68 - '78 average weights at age (kg)									
Age	1	2	3	4	5	6	7	8	9	10
	.010	.041	.112	.172	.218	.254	.286	.323	.354	.389

Table 14 shows the mean weights at age presented in annual assessment documents. In several cases, it is not clear how these were derived, or if they were used in projections. This year, weight at age was calculated in several ways for comparison. Table 15 contains mean (± SD) weight at age by month of herring (n=7857) from biological samples collected from the 4X fishery (sample distribution as shown in Table 6). Table 16 presents mean weight at age calculated by month and weighted by gear for the stock

components of the 1984 4WX fishery. Table 17 compares several weights at age.

Sinclair et al. (1980) (CAFSAC Res. Doc. 80/21) presents mean July weight at age for the 4WX stock (weighted by gear) for the years 1968-78. We have extended that series, using average July weights at age for the years 1979-83 and our calculated series for 1984 (Table 18). The 1984 July weights at age (mean for stock fish weighted by gear) are as follows:

	1984 weights at age								
Age	2	3	4	5	6	7	8	9	10
	038	.132	.191	.229	.259	.280	.296	.309	.364

B) Catch Matrix

The "nominal" catch matrix (using DFO Statistics Branch data) is reproduced at Table 19. Minor changes have been made to the historical matrix (1968-83) as a result of previous transcription errors.

A new "adjusted" catch matrix (from Mace 1985) which incorporates misreporting from 1973 to 1984 is presented in Table 20. The adjusted matrix differs from the nominal matrix by the following factors:

(adjusted/nominal):

Year	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Adjustment	-	-	-	-	-	1.28	1.29	1.30	1.16	1.12	1.11	1.11	1.32	1.46	1.33	1.46	1.64

(These factors differ from the previous text table (p. 7) in being for numbers (ages 1 to 10) rather than for total weight landed).

C) Partial recruitment

The partial recruitment pattern was changed from previous years after consideration of the population structure of the overwintering aggregation of herring in Chedabucto Bay, the pattern of the fishing mortality matrix and the increase in directed effort for small fish (as a result of low 4Xb weir landings in 1983 and 1984). The partial recruitment vector chosen and that of 1983 are presented below:

Age	1	2	3	4	5	6	7	8	9	10
PR 1984	.002	.5	1	1	1	1	1	1	1	1
PR 1983	.01	.22	.53	1	1	1	1	1	1	1

D) Sequential population analysis

Sequential population analysis (SPA) was undertaken for both the nominal and adjusted catch matrices, calibrated with larval abundance indices as in previous years.

Regression of larval abundance on population biomass (mature and 5+ biomass) indicated terminal F values of .3 for the adjusted matrix and .225 for the nominal matrix, based upon the highest correlation coefficient (Table 21; Fig. 5). Regression of larval abundance on estimated egg production confirmed these values.

Cohort analysis (Tables 22-24) indicated an increase in stock biomass over recent years. The 1979, 80, and 81 year-classes appear to be reasonably strong; the 1976 year-class dominates older age groups.

Trends in population biomass (age 2+) using both adjusted and nominal catch matrices are presented below:

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
2+ popn biomass ('000 t)										
Adjusted matrix	454.8	370.7	282.2	251.3	386.5	407.5	380.5	403.8	445.4	464.0
Nominal matrix	383.1	320.9	239.0	197.6	286.0	294.4	278.2	299.3	332.6	368.7

A new calculation of the geometric mean recruitment (at age 1) was made using each catch at age matrix for 1965-81 with appropriate terminal F values. The values were 1,575,210 and 1,846,300 t for the nominal and adjusted matrices, respectively.

E) Yield per recruit

Because of the significant change in partial recruitment pattern over previous years, a Thompson and Bell Y/R analysis was made using long term average weights at age. The resulting $F_{0.1}$ value of 0.254 gives a yield per recruit of 63 gm.

CATCH PROJECTIONS

A range of catch projections are presented in Appendix 2.

MANAGEMENT CONSIDERATIONS

1) Misreporting

Misreporting in the 4WX herring fishery is not new; since 1980 all CAFSAC assessment documents for this stock have contained comments about misreporting and the potential effect this has on scientific advice. During 1984, however, the issue came to a head. There was agreement by all sectors of the industry that the degree of misreporting was high and there was a realization that it could seriously jeopardize the assessment process. DFO was unable

to document landings in excess of the quota in 1984, but did make a request of CAFSAC in December 1984 for additional projections based upon 1985 landings of 107,600 t (derived from Fishery Officer hails). A number of meetings have been held and proposals made concerning the misreporting issue. These culminated at a meeting of DFO and Industry (chaired by the Director-General of Scotia-Fundy Region, Yarmouth, April 1-3, 1985) at which a draft management plan for 1986 was prepared. The main points of that proposed management plan are listed in Appendix 3. The quota (of 100,000 t for the purse seine segment and an allowance for other gear) exceeds scientific advice by a considerable amount. However, the proposal also contained steps to improve monitoring and to enforce the quota.

At the 1985 CAFSAC meetings, the Pelagic Subcommittee accepted the use of the adjusted matrix as the basis for assessment of this stock, recognizing that it assumes accurate catch information and actual landings. The TAC set for 1985 is above the $F_{0.1}$ level even for the adjusted matrix.

Recent events in this fishery are cause for concern. The concentration of effort on spawning fish as a result of the roe market increases the possibility of depletion of localized spawning units. Increased directed effort on small fish of the 4WX stock, as a result of continued low catches in the New Brunswick weir fishery decreases yield per recruit and changes the assumptions on which projections have been based.

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Table 1. Gear types involved in the 1984 4WX herring fishery.

Gear	Number	Landings Nominal (t)	% of total	Comments
Purse seine	43 vessels	70,373	79	Three fisheries: 4Xa summer 4Wa winter 4Xb fall and winter
Gillnet NB=77 NS=277	licensed vessels	4,490	5	223 vessels were active
Weirs 253	licensed	11,058	12	N.B. = 232 N.S. = 21
Traps	One major trap	470	1	Liverpool, N.S.
Shutoffs	47 licensed	324	0.4	4Xb
Midwater trawl	1 license	66	0.07	4Xb

Table 2. Major markets for the 1984 4WX herring fishery.

Market	% by weight of nominal catch	Notes
Over side sales	21	>9.5"; <30% with feed
Roe	35-51	Ripe fish
Sardine	15-25	Small fish
Bloater	15-30	
Frozen round		
Fillets		
Fresh		
Cured & pickled		
Smoked		
Meal		
Oil		
Bait		

Table 3. Catch (t) by gear component and month for the 1984 4WX herring fishery (data from DFO, Scotia-Fundy Region, Statistics Branch; MFD Tape EMF778).

Gear segment	1983			1984												Total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
4WX stock																
4Wa purse seine	0	2790	1309	1317	720	200	0	0	0	0	0	0	0	-	-	6336
4Xa purse seine	-	-	-	0	0	0	0	75	822	10407	22412	22513	2125	0	0	58354
4Xb purse seine	3064	577	0	1755	287	0	0	0	0	0	0	0	0	-	-	5683
4Xa gillnet[a]	-	-	-	0	0	0	0	26	98	193	1189	2980	4	0	0	4490
4Xa (NS) weirs[b]	-	-	-	0	0	0	0	113	1032	736	583	220	0	0	0	2684
4Xa (NS) traps	-	-	-	0	0	0	18	21	128	221	24	58	0	0	0	470
4Xb midwater trawl	-	-	-	5	61	0	0	0	0	0	0	0	0	0	0	66
Stock total	3064	3367	1309	3077	1068	200	18	235	2080	11557	24208	25771	2129	0	0	78083
4WX non-stock																
4Xb (NB) weirs	-	-	-	0	0	0	0	5	3	230	2363	2581	3046	146	0	8374
4Xb (NB) shutoffs	-	-	-	0	0	0	0	0	0	0	100	126	98	0	0	324
4Xa misc.[c]	-	-	-	0	0	0	0	27	153	143	24	60	35	3	0	445
4W misc.[d]	-	-	-	4	7	17	174	52	214	829	130	22	5	0	0	1454
Non-stock total				4	7	17	174	84	370	1202	2617	2789	3184	149	0	10597
Total 4WX	3064	3367	1309	3081	1075	217	192	319	2450	12759	26825	28560	5313	149	0	88680

[a] 4Xa gillnet includes all except 4Xm (combined with 4Xa misc.).
[b] 4X traps includes Liverpool but not 4Xm.
[c] 4Xa misc. includes 4Xm gillnet, 4Xm traps, handline + longline bycatches.
[d] 4W misc. includes all gear other than purse seine.

Table 4. Annual landings by major components of the 4WX herring fishery (1963-84 from Iles et al. MS 1984; CAFSAC Res. Doc. 84/72, except as noted).

	4Wa	4Xa			4Xb		
Year	Purse seine	Purse seine	Gillnet	Weir	Purse seine	Weir & shutoff	Stock total
1963		15093	2955	5345	6871	29366	
64		24894	4053	12458	15991	29432	
65		54527	4091	12021	15755	33346	86394
66		112457	4413	7711	25645	35805	150226
67		117382	5398	12475	20888	30032	156741
68		133267	5884	12571	42223	33145	196362
69	25112	84525	3474	10744	13202	26539	150462
70	27107	74849	5019	11706	14749	15840	190382
71	52535	35071	4607	8081	4868	12660	129101
72	25656	61158	3789	6766	32174	32699	153449
73	8348	36618	5205	12492	27322	19935	122687
74	27044	76859	4285	6436	10563	20602	149670
75	27030	79605	4995	7404	1152	30819	143897
76	37196	58395[a]	8322	5959	746	29206	115178[a]
77	23251	68538	18523	5213	1236	23487	117171
78	17274	57973	6059	8057	6519	38842	95882
79	14073	25265	4363	9307	3839	37828	59021
80	8958	44986	19804	2383	1443	13525	79584
81	18588	53799	11985	1966	1368	19080	87706
82	12275	64344	6799	1212	103	25963	84733
83	8226	63379	8762	918	2157	11383	84385
84	6336	58354	4490	2684	5683	8698	78083

[a]Correction of previous transcription error.

Table 5. 4WX herring purse seine logbook coverage for the 4Xa and 4Xb portions of the 1984 fishery.

		Area 4Xa	4Xb	4W
Number of vessels represented		26 of 43 = 60%		8
Days (records) covered by logs		486	44	111
Stats Div. total successful nights (= trips)		1483		-
Portion of total successful nights covered		36%		-
Catch accounted for in logs	t	25308	1252	3088
	%	43	22	49
CPUE (t/successful night)		52.07	28.45	27.82

Table 6. Distribution of biological samples from the 1984 4WX commercial herring fishery; detail fish = number of fish taken for detail analysis including ageing, LF samples = number of length-frequency samples, catch/detail = ratio of monthly catch (t) to the number of biological detail samples taken for that segment.

Gear component		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4Wa purse seine	- detail fish		411	210	643	283	*									
	- LF samples	-	15	14	14	7 →		-	-	-	-	-	-			
	- catch/detail		310	262	94	153										
4Xa purse seine	- detail fish									*	615	661	937	222		
	- LF samples				-	-	-	-	←	2 —	184	376	195	15	-	-
	- catch/detail										578	1067	804	304		
4Xb purse seine	- detail fish	364	403		72*	*										
	- LF samples	20	3	-	3 →		-	-	-	-	-	-	-			
	- catch/detail	180	30		681											
4Xa gillnet	- detail fish											*	192*	139*		
	- LF samples				-	-	-	-	←	7 —	8 —	23	20 →		-	-
	- catch/detail											198	746			
4Xa (NS) weirs	- detail fish									319	385	179	189			
	- LF samples				-	-	-	←	2 —	15	19	10	5 →		-	-
	- catch/detail									69	92	146	55			
4Xa (NS) traps	- detail fish									211		*				
	- LF samples							←	1	— 6	—	→		-	-	-
	- catch/detail									10						
4Xb midwater trawl	- detail fish				155[a]											
	- LF samples				[1 ←	→ 1]	-	-	-	-	-	-	-	-	-	-
	- catch/detail				1											
4Xb (NB) weirs	- detail fish									46	368	849	932	625	135*	
	- LF samples				-	-	-	-	←	2 —	18	51	57	37	7	-
	- catch/detail										18	74	70	117	21	
4Xb (NB) shutoffs	- detail fish											231	257	19		
	- LF samples				-	-	-	-	-	-	-	[2 ←	→ 5 ←	→ 1]	-	-
	- catch/detail											b	b	b		
4WX misc.	- detail fish															
	- LF samples								c							
	- catch/detail															

- cells with no landings.
* cells undersampled according to criteria outlined in text.
[a] includes 4Xb purse seine detail sample.
[b] combined with weir detail samples.
[c] combined monthly detail and LF information used.

Table 7. Number at age for two adjacent 10' squares of the 4Xa purse seine fishery, calculated using individual length frequencies but the same age composition and catch weight (assumed to be 100 t). Trinity = square 440-661 and 435661; McDormand Patch square = 440662.

Diff (%) calculated as $[(\text{Trinity} - \text{McDormands})/(\frac{\text{Trinity} - \text{McDormands}}{2})] \times 100$.

		2	3	4	5	6	7	8	9	10	11+	Total
Aug.	Trinity	9	58	214	112	22	17	23	5	1	2	461
	McDormands	123	256	202	61	11	5	6	1	0	0	664
	% diff.	173	126	6	59	67	109	117	133	200	200	36
Sept.	Trinity	2	74	222	120	6	10	22	9	2	3	471
	McDormands	491	144	129	58	3	6	16	6	1	4	860
	% diff.	198	64	53	70	67	50	32	40	67	29	58

Table 8. 4Xa purse seine a) number at age by month calculated for entire area combined (area) and as the sum of calculations by individual squares (square);
b) percent difference = $[(\text{area} - \text{square}) \div (\frac{\text{area} + \text{square}}{2})] \times 100$.

		2	3	4	5	6	7	8	9	10	11+	Total
a)												
May-June	area	0	80	1335	1670	306	247	180	43	12	12	3886
	square	0	100	1404	1664	301	232	168	38	9	9	3926
July	area	3691	16374	17236	12762	2200	1638	1802	357	194	202	56456
	square	2136	16594	18227	12646	2052	1514	1651	326	50	339	55534
August	area	6867	27081	43615	23538	4325	3148	3989	575	225	156	113419
	square	6049	31097	43991	22362	4049	2922	3739	536	212	170	115128
September	area	13743	21295	38438	30546	3335	2990	5041	2182	390	171	118132
	square	8225	21432	39293	31027	3362	2978	5073	2172	387	194	114144
October	area	6109	5211	2379	1693	305	332	210	30	14	0	16283
	square	3153	6010	2671	1816	323	310	186	24	15	0	14507
b)												
May-June		0	-22	-5	.4	.2	6	7	12	29	29	-1.02
July		53	-1	-6	1	7	8	9	9	118	-51	1.65
August		13	-14	-1	5	7	7	6	7	6	-9	-1.44
September		50	-1	-2	-2	-1	.4	-.6	.5	.8	-13	3.43
October		64	-14	-12	-7	-6	7	12	22	-7	0	11.54

Table 9. Nominal catch at age in numbers (thousands) and weight (t) by gear component for the 1984 4WX herring fishery.

		1	2	3	4	5	6	7	8	9	10	11+	Total
4WX "stock"													
4Wa purse seine	No.	0	8	1642	6916	8042	1145	2228	4115	2225	522	3547	30390
	Wt.	0	0	133	920	1349	233	505	1077	664	161	1294	6336
4Xa purse seine	No.	0	19563	75233	105586	69515	10087	7956	10817	3096	673	712	303238
	Wt.	0	1266	10389	20599	16140	2573	2372	3447	1039	248	281	58355
4Xb purse seine	No.	0	1380	56210	8411	1892	564	12	653	0	0	60	69182
	Wt.	0	33	4091	905	351	134	2	160	0	0	7	5683
4Xa gillnet	No.	0	0	900	7799	3826	1351	2695	236	61	0	725	17593
	Wt.	0	0	158	1681	949	423	864	76	22	0	316	4491
4Xa (NS) weirs	No.	0	49333	5910	1668	1144	280	700	444	36	68	87	59670
	Wt.	0	1115	573	282	242	69	192	133	13	26	40	2685
4Xa (NS) traps	No.	0	24	514	870	501	206	212	34	0	0	76	2437
	Wt.	0	1	56	163	115	55	68	12	0	0	0	469
4Xb midwater trawl	No.	0	1993	658	1	0	0	0	0	0	0	0	2652
	Wt.	0	30	36	0	0	0	0	0	0	0	0	66
Stock total	No.	0	72301	141067	131251	84920	13633	13803	16299	5418	1263	5207	485 162
	Wt.	0	2445	15436	24550	19146	3488	4004	4904	1738	435	1939	78084
4WX "non-stock"													
4Xb (NB) weirs	No.	9199	78599	16920	5525	4279	603	249	15	85	0	0	115474
	Wt.	107	3935	2078	1009	981	158	71	5	30	0	0	8374
4Xb (NB) shutoffs	No.	5154	4321	372	133	53	8	2	0	0	0	0	10043
	Wt.	72	168	45	24	12	2	1	0	0	0	0	324
4WX misc.	No.	0	3666	2696	2557	2143	524	936	354	63	76	43	13058
	Wt.	0	91	310	468	461	135	261	108	20	26	18	1899
Non-stock total	No.	14353	86586	19988	8215	6475	1135	1187	369	148	76	43	138575
	Wt.	179	4194	2433	1502	1453	295	333	113	50	26	18	10597
GRAND TOTAL	No.	14353	158887	161055	139466	91395	14768	14990	16668	5566	1339	5250	623737
	Wt.	179	6639	17869	26052	20599	3783	4336	5017	1788	462	1956	88680

Table 10. CPUE trends for components of the 4WX herring fishery. Data for 1965-83 as in Iles et al. (1984 - CAFSAC Res. Doc. 84/72).

Year	Purse seine			Fixed gear	
	4Xa[a]	4Wa[a]	4Xa Gillnets[b]	4Xa NS weirs[c,d]	4Xb NB weirs[c,e]
1965	-	-		481	162
1966	-	-		308	183
1967	55.5	-		499	153
1968	52.8	-		503	165
1969	41.7	-		430	132
1970	39.0	-		468	77
1971	32.6	109.7		323	62
1972	45.0	62.6		271	164
1973	49.1	69.7		500	98
1974	53.4	143.1		257	98
1975	57.4	142.7		296	158
1976	44.6	125.4		238	150
1977	37.4	97.9	4.2	209	106
1978	39.5	85.7	1.6	269	172
1979	31.7	70.1	2.1	372	167
1980	28.5	63.4	3.0	95	57
1981	42.0	76.8	4.4	79	80
1982	40.6	68.7	3.44	48	114
1983	34.8	51.0	2.29	37	54
1984	52.0	27.8	2.12	107	43

[a]Catch (t) per successful night (= trip).
[b]t/purchase slip (areas 32-37).
[c]t/weir.
[d]No. of weirs = 25.
[e]No. of weirs = 195.

Table 11. 4WX larval herring abundance indices; from number of larvae per m^2 (to bottom) of all stations sampled (n = 116-150) for each year.

Year	Arithmetic mean	Geometric mean
1972	7.24	2.64
1973	5.27	2.30
1974	37.49	7.60
1975	24.56[a]	6.02[a]
1976	11.62	4.44
1977	4.57	1.83
1978	3.51	1.24
1979	6.32	2.18
1980	19.48	4.61
1981	2.59	1.50
1982	9.10	3.73
1983	11.33	4.29
1984	13.48	5.13

[a]Interpolated.

Table 12. Comparison of estimates of larval herring abundance from duplicate (port and starboard) bongo net pairs in two cruises.

	No. of stations	Larvae mean no. Port	Stbd	t	Prob.	Larvae per m^3 Port	Stbd	t	Prob.
P268									
All fish	118	2.82	2.96	-.57	.572	.702	.736	-.56	.577
Herring	118	1.42	1.48	-.37	.710	.344	.360	-.39	.699
P217									
All fish	107	5.88	6.85	-.94	.350	1.495	1.729	-.89	.377
Herring	107	1.13	1.22	-.24	.813	.28	.30	-.24	.811

Table 13. Larval herring numbers in repetitive bongo net tows at a single station over a period of 10 h; E.E. PRINCE Cruise #158.

Port	Starboard	Mean #	Difference	% difference
3167	3138	3153	15	1
1984	-			
2464	2382	2423	41	2
2470	2609	2540	69	3
1744	-			
2110	-			

$\bar{X}$ = 2323, SD = 500

Table 14. Mean weight at age for 4WX herring as presented in annual assessment documents for 1973-83.

Age	1973 ICNAF Res. Doc. 74/13	1975 ICNAF Res. Doc. 76/VI/45	1976 CAFSAC Res. Doc. 77/11	1977 CAFSAC Res. Doc. 78/25	1978 CAFSAC Res. Doc. 79/19	1979 CAFSAC Res. Doc. 80/47 Option 1	1980 CAFSAC Res. Doc. 81/10[a]	1981 CAFSAC Res. Doc. 82/36[b]	1982 CAFSAC Res. Doc. 83/89[c]	1983 CAFSAC Res. Doc. 84/72[d]
1	-			-	9	10.64	9.5	-	8.54	10
2	31			29.6	30	24.37	35.5	19	51.79	41
3	114			97.7	93	93.93	86.9	35	137.42	112
4	159	"as per	"mean wts	165.8	159	164.75	173.4	172	176.26	172
5	227	assessment	from 4XWb	207.1	205	226.00	220.7	216	229.67	218
6	270	presented	were used"	261.5	250	253.13	258.3	202	256.34	254
7	299	in Jan.		280.7	285	285.86	305.3	262	287.47	286
8	334	1976"		300.2	315	314.75	333.0	325	319.62	323
9	360			328.6	341	343.85	359.2	362	362.61	354
10	386			349.0	382	369.52	369.7	385	377.64	389

[a]Also first use of 'Mean July 1969 to 1978' as used in 'W83'. Used both 'Fishery' and 'Mean' in cohort mean for projections.
[b]As for a), i.e. fishery and mean for cohort and YPR but mean for projections.
[c]Used 'mean July 1969 to 1978' only. No fishery weights calculated.
[d]Also used mean July 1969 to 1978 weights which are different from a).

Table 15. Mean and standard deviation of weight at age by month calculated from fish (n=7857) collected in the 1984 4X herring fisheries (all gears).

	Months																	
	Jan.		Feb.		May		June		July		Aug.		Sept.		Oct.		Nov.	
Age	Wt	SD	Wt	SD	Wt	SD	Wt	SD	Wt	SD	Wt	SD	Wt	SD	Wt	SD	Wt	SD
1	0	0	0	0	0	0	0	0	18.4	-	7.4	1.9	8.8	3.8	14.3	6.5	14.2	7.1
2	25.1	5.7	17.5	10.8	20.3	13.2	24.0	12.3	39.6	19.4	49.8	20.3	54.3	21.7	58.3	22.2	59.8	23.4
3	74.3	23.5	62.3	18.3	60.3	21.1	93.4	41.2	119.1	32.2	130.8	31.1	134.4	26.6	134.6	24.5	131.6	22.5
4	137.7	28.7	0	0	123.9	27.2	191.7	41.0	196.0	32.8	198.2	29.3	192.3	32.7	185.9	25.7	176.3	21.7
5	197.5	3.6	0	0	178.3	26.7	247.1	41.2	243.0	34.5	251.3	33.1	240.9	40.2	222.1	33.6	225.3	22.4
6	0	0	0	0	233.3	-	292.6	43.4	270.5	32.2	276.3	34.4	277.3	42.7	250.3	23.8	257.3	38.0
7	288.9	-	0	0	237.1	35.5	323.3	44.8	295.0	36.8	312.9	38.9	311.3	55.3	299.0	41.1	257.7	12.4
8	291.2	-	0	0	0	0	330.5	34.3	315.5	40.7	344.1	42.6	339.4	47.8	331.2	38.1	276.0	-
9	0	0	0	0	0	0	0	0	370.3	56.6	356.9	46.7	361.3	44.7	369.2	51.3	0	0
10	0	0	0	0	0	0	0	0	391.6	37.4	406.3	50.7	377.4	20.3	386.0	-	0	0

Table 16. Mean weights at age calculated by month and weighted gear for the stock portion of the 1984 4WX herring fishery.

	1984 4WX stock mean weight at age (GMS) by month weighted by GEAR01 to GEAR07														
Age	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	23.9	15.1	0.0	0.0	15.1	22.8	37.5	64.1	64.3	71.5	0.0	0.0
3	75.9	70.2	81.8	71.1	63.2	0.0	0.0	74.5	77.5	132.1	139.1	139.8	134.6	0.0	0.0
4	107.4	115.5	116.9	136.2	133.2	0.0	0.0	164.7	201.0	191.4	200.7	194.3	173.2	0.0	0.0
5	188.7	170.1	159.0	172.6	167.8	0.0	0.0	199.7	232.7	228.7	238.0	231.3	217.6	0.0	0.0
6	237.8	198.2	209.0	201.5	207.5	0.0	0.0	251.1	266.0	259.1	257.2	270.0	229.5	0.0	0.0
7	205.9	219.2	222.7	230.7	226.4	0.0	0.0	268.3	302.2	279.8	307.9	310.1	292.0	0.0	0.0
8	239.9	259.2	270.6	253.4	251.9	0.0	0.0	0.0	289.7	296.2	332.7	317.2	305.9	0.0	0.0
9	0.0	308.4	279.8	281.1	308.6	0.0	0.0	0.0	306.1	309.0	338.0	341.1	341.7	0.0	0.0
10	0.0	323.5	296.8	0.0	0.0	0.0	0.0	0.0	339.6	364.0	379.9	366.8	381.1	0.0	0.0

Table 17. Weight at age (kg) calculated for different components and samples of the 4WX herring fishery.

	Age 1	2	3	4	5	6	7	8	9	10
1) 1969-78 4Xa stock fishery, July (mean)	.010	.041	.112	.172	.218	.254	.286	.323	.354	.389
2) 1984 4Xa purse seine fishery, for all months	.000	.064	.138	.195	.232	.255	.298	.318	.335	.368
3) 1984 4Xa purse seine fishery, July	.000	.050	.134	.912	.229	.259	.374	.296	.300	.340
4) 1984 4Xa purse seine fishery, August	.000	.065	.140	.201	.238	.256	.311	.334	.332	.380
5) 1984 4WX stock fisheries, for all months	.000	.034	.109	.187	.225	.256	.290	.301	.321	.345
6) 1984 4WX entire fishery, July	.004	.035	.130	.191	.228	.259	.280	.297	.310	.366
7) 1984 4WX stock fishery, July	.000	.038	.132	.191	.229	.259	.280	.296	.309	.364
8) 1984 4X detail sample, mean July	.018	.040	.119	.196	.243	.271	.295	.316	.370	.392
9) 1984 4X detail sample, mean August	.007	.050	.131	.198	.251	.276	.313	.344	.357	.406

Table 18. July weights at age for the 4WX herring fishery (stock portion); 1968-84. Values for 1968-78 from Sinclair et al. (1980, CAFSAC Res. Doc. 80/21); values for 1979-83 are averages for the period 1968-78 (as in Iles et al. 1984, CAFSAC Res. Doc. 84/72); 1984 values have been calculated from the 1984 fishery.

	July mean weights at age (GMS) for the 4WX herring fishery 1968 to 1984																
Age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0	10.0	10.0	10.0	0.0
2	32.7	37.2	31.7	66.1	44.3	28.8	47.7	20.8	32.7	65.2	28.3	41.0	41.0	41.0	41.0	41.0	37.5
3	33.0	105.5	119.2	142.6	137.6	105.7	110.2	94.3	114.1	113.3	112.1	112.0	112.0	112.0	112.0	112.0	132.1
4	148.0	162.3	168.7	199.1	192.3	143.3	175.4	179.0	159.1	174.2	180.8	172.0	172.0	172.0	172.0	172.0	191.4
5	184.6	207.2	210.6	230.1	224.5	224.6	205.6	215.6	233.4	213.7	228.6	218.0	218.0	218.0	218.0	218.0	228.7
6	244.4	241.8	256.8	253.6	262.0	251.5	239.9	239.6	249.4	274.2	258.6	254.0	254.0	254.0	254.0	254.0	259.1
7	275.7	282.0	292.2	292.7	291.5	291.5	279.1	277.2	267.5	277.2	293.0	302.1	286.0	286.0	286.0	286.0	279.8
8	399.0	305.8	332.0	328.8	321.7	331.2	233.1	333.2	317.3	325.3	330.2	323.0	323.0	323.0	323.0	323.0	296.2
9	337.8	333.7	368.6	362.0	345.0	359.9	342.4	357.8	382.4	328.1	351.0	354.0	354.0	354.0	354.0	354.0	309.0
10	409.5	390.4	389.3	387.7	380.4	388.9	352.0	379.0	404.2	415.7	397.1	389.0	389.0	389.0	389.0	389.0	364.0

Table 19. Nominal catch matrix for the 4WX herring fishery, 1973-84. Values for 1973-83 are as in the previous assessment (Iles et al. CAFSAC Res. Doc. 84/72) except as noted.

	4WX herring nominal numbers at age in thousands for stock components only											
Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	754	14151	2870[a]	240[a]	1164[a]	35381[a]	311	1623	0			
2	126421	596153	264491	48470	140494	346719	170523	9566	75713	72591	128378	72301
3	595992	72381	180898	176226	28659	36177	226442	60559	33174	122380	101017	141067
4	109530	616622	92487	130598	192958	11338	47200	359484	68816	17756	168379	131251
5	34422	53199[a]	384646	72334	106061	107627	4639	21958	306716	73025	16946	84920
6	25562	15254	50599	219788	55066	60431	19695	3583	21728	154542	41607	13633
7	19361	8120	9357	18960	150588	27286	15521	3507	1631	10910	63468	13803
8	17604	5313	3238	4967	12466	96741	9981	4951	1914	1535	7334	16299
9	19836	10964	3481	3556	2873	9838	35386	2009	1366	977	1351	5418
10	9661	5787	2842	1835	1253	2169	3834	8179	361	886	434	1263

[a]Transcription error/revisions from previous assessments.

Table 20. Catch matrix for the 4WX herring fishery adjusted to account for apparent underreporting. (from Mace, 1985).

	4WX herring adjusted numbers at age in thousands for stock components only											
Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	1018	18411	3199	240	1170	35381	342	2339	0	3589	5488	0
2	167454	766064	317640	55596	153921	383611	183982	12503	103051	102133	191682	88433
3	781061	93606	239827	206535	31572	40887	250393	80518	50883	150764	150328	243542
4	130851	803651	124599	153782	218478	12906	54620	474091	102743	22640	244007	224354
5	40128	68276	514605	68804	119234	122108	5430	27929	451482	98206	24483	146096
6	30334	19093	66302	268839	51173	68410	23142	4373	32978	211043	60678	22716
7	22046	10232	12298	21460	177247	31088	18255	4692	2418	14627	89982	21654
8	20249	6565	4409	5571	13977	108975	11836	6560	2766	2080	10352	28299
9	23871	12785	4778	3951	3170	11082	41389	2985	1917	1354	1728	9515
10	11630	7102	3847	2059	1415	2425	4527	10641	538	1250	642	2183

Table 21. Intercepts and r of the regression of SPA derived biomass vs larval abundance for a range of terminal F values; A = Nominal Matrix, B = Adjusted Matrix.

	Mature Biomass		5+ Biomass	
Terminal F	r	intercept	r	intercept
A) NOMINAL MATRIX				
.15	.766	86677	.814	34421
.20	.845	81008	.860	30303
.225	.850	79120	.860	28930
.25	.838	77612	.852	27833
.30	.789	75350	.823	26186
.35	.734	73736	.791	25012
B) ADJUSTED MATRIX				
.20	.742	116481	.798	47687
.25	.817	110713	.842	43545
.30	.841	106870	.851	40780
.35	.825	104130	.839	38809
.40	.790	102078	.818	37334

Table 22. 4WX herring population numbers at age estimated from SPA using nominal and adjusted catch matrixes.

Nominal POPULATION NUMBERS 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	1910734	1410949	222800	683194	3378703	1062330	347563	1675907	1569267	1325372	917715	1576036
2	807510	1563695	1142383	179816	559135	2765195	837749	284279	1370648	1284807	1081875	748315
3	3482326	546743	740823	695983	103364	330657	1950226	531595	224092	1053684	986228	769603
4	399278	2311812	382142	442852	410367	58695	237984	1391817	380437	153454	751949	716051
5	102315	227795	1334809	229186	244406	161384	37797	152137	814248	249208	109571	463288
6	58944	52622	138366	744807	122191	104135	34745	26748	104691	389122	137959	74376
7	45516	25130	29281	67501	410924	50216	30578	10626	18657	66053	178751	75303
8	46362	19747	13227	15507	38109	200178	16424	10991	5527	13799	44208	88921
9	43034	22029	11360	7900	8202	19921	76357	4415	4519	2793	9909	29558
10	22466	17285	8115	6151	3250	4115	7408	30497	1797	2464	1403	6890
1+	6918486	6197806	4023307	3072895	5278650	4756827	3576831	4119012	4493883	4540756	4219568	4548343
2+	5007752	4786857	3800507	2389701	1899947	3694496	3229268	2443105	2924617	3215385	3301853	2972307
3+	4200242	3223162	2658124	2209885	1340812	929302	2391520	2158826	1553969	1930578	2219978	2223992
4+	717916	2676419	1917300	1513902	1237448	598645	441294	1627232	1329876	876894	1233750	1454388

Adjusted POPULATION NUMBERS 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	2367059	1648280	266715	852901	4447392	1355463	468512	2258871	2117316	1801681	859500	1847768
2	943761	1937063	1332839	215474	698079	3640158	1077745	383276	1847291	1733512	1471844	698733
3	4418005	621167	892770	803823	126110	432266	2633204	715909	302486	1419189	1326866	1031603
4	488044	2910423	423871	513933	471234	74683	316913	1929321	513281	201614	1025517	950324
5	122524	281177	1655679	234294	281626	188127	49467	210044	1150619	327274	144582	618836
6	71051	64005	168430	889921	129567	122688	43537	35587	146698	533529	179089	96221
7	53443	30724	35127	77906	485350	59777	38548	14706	25180	90267	245857	91722
8	54710	23807	15896	17631	44366	236992	20812	15043	7794	18427	60669	119871
9	51989	26471	13551	9025	9394	23677	95428	6330	6380	3878	13205	40305
10	27546	20965	10104	6771	3814	4823	9358	40680	2482	3489	1950	9247
1+	8596131	7564082	4814981	3621681	6696932	6138654	4753525	5609766	6119527	6132860	5329078	5504630
2+	6231072	5915802	4548266	2768779	2249540	4783191	4285012	3350895	4002211	4331179	4469578	3656862
3+	5287311	3978739	3215427	2553306	1551460	1143032	3207267	2967619	2154920	2597667	2997734	2958129
4+	869306	3357572	2322657	1749483	1425351	710767	574063	2251710	1852434	1178478	1670868	1926526

Table 23. 4WX herring biomass from SPA using nominal and adjusted catch matrices.

Nominal MEAN POPULATION BIOMASS (KG) 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	17314	12719	2005	6191	30617	9456	3149	15182	14223	11995	8301	14257
2	19258	52542	18737	4515	28358	66053	27597	10373	49414	46287	37593	24118
3	302008	50641	54611	61689	8943	31588	185400	50603	20894	100167	94522	82800
4	43786	312004	53552	53117	46474	8585	33002	185305	53356	22409	102514	111652
5	16786	36881	218033	39705	35136	18851	6966	27673	125516	41013	19803	86304
6	9975	9552	23656	140017	22193	15523	5171	5705	21309	68690	26286	15700
7	8613	5141	5797	14251	85857	9134	5475	2231	4606	15559	36794	17167
8	10830	4886	3444	3639	9121	42422	2953	2352	1294	3794	11755	21456
9	10160	4771	3038	2002	1944	4440	17689	1031	1199	715	2941	7440
10	5926	4461	2228	1873	952	1011	1800	9132	563	689	408	2043
1+	444656	493598	385101	327000	269596	207063	289201	309585	292375	311318	340918	382938
2+	427342	480878	383096	320809	238979	197607	286052	294404	278152	299323	332616	368681
3+	408084	428337	364359	316294	210621	131554	258455	284031	228738	253036	295024	344563
4+	106076	377695	309748	254604	201678	99966	73055	233428	207844	152869	200502	261763

Adjusted MEAN POPULATION BIOMASS (KG) 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	21449	14850	2402	7729	40303	12113	4245	20462	19190	16312	7763	16733
2	22212	64308	21760	5455	36160	88000	36266	13993	66578	62367	50787	22125
3	381781	56891	64690	71061	11122	41658	253461	68207	27849	135712	126352	107211
4	53759	390156	57239	61445	53709	11067	44690	259131	71092	29501	138482	143139
5	20241	45234	265929	41263	40876	22585	9188	38473	175040	53580	25891	111358
6	12098	11547	28131	166430	24738	18794	6747	7641	29517	94311	33165	19621
7	10229	6237	6790	16513	101513	11157	7144	3114	6186	21304	50161	20199
8	12883	5862	4044	4151	10717	51387	3930	3262	1812	5062	16084	27940
9	12295	5819	3496	2313	2250	5414	22730	1455	1696	993	3933	9800
10	7316	5394	2708	2053	1130	1214	2351	12237	770	977	558	2649
1+	554261	606297	457189	378414	322516	263389	390752	427974	399728	420119	453176	480773
2+	532813	591447	454787	370685	282213	251276	386507	407513	380538	403807	445412	464041
3+	510600	527140	433027	365230	246053	163276	350241	393520	313960	341441	394625	441916
4+	128820	470249	368337	294169	234931	121618	96780	325313	286112	205729	268273	334705

Table 24. 4WX herring fishery mortalities at age estimated from nominal and adjusted catch matrices.

Fishing mortality (nominal catch at age) 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0.000	0.011	0.014	0.000	0.000	0.038	0.001	0.001	0.000	0.003	0.004	0.004
2	0.190	0.547	0.296	0.354	0.325	0.149	0.255	0.038	0.063	0.064	0.141	0.112
3	0.210	0.158	0.315	0.328	0.366	0.129	0.137	0.135	0.179	0.137	0.120	0.225
4	0.361	0.349	0.311	0.394	0.733	0.240	0.247	0.336	0.223	0.137	0.284	0.225
5	0.465	0.299	0.383	0.429	0.653	1.336	0.146	0.174	0.538	0.391	0.187	0.225
6	0.653	0.386	0.518	0.395	0.689	1.025	0.985	0.160	0.261	0.578	0.405	0.225
7	0.635	0.442	0.436	0.372	0.519	0.918	0.823	0.454	0.102	0.202	0.498	0.225
8	0.544	0.353	0.315	0.437	0.449	0.764	1.114	0.689	0.482	0.131	0.203	0.225
9	0.712	0.799	0.413	0.688	0.490	0.789	0.718	0.699	0.407	0.489	0.163	0.225
10	0.634	0.457	0.483	0.396	0.547	0.852	0.828	0.348	0.249	0.500	0.414	0.225
4+	0.459	0.351	0.380	0.401	0.631	0.926	0.460	0.322	0.419	0.412	0.316	0.225

Fishing mortality (adjusted catch at age) 15/ 5/85

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0.000	0.012	0.013	0.000	0.000	0.029	0.001	0.001	0.000	0.002	0.007	0.002
2	0.218	0.575	0.306	0.336	0.279	0.124	0.209	0.037	0.064	0.067	0.155	0.150
3	0.217	0.182	0.352	0.334	0.324	0.110	0.111	0.133	0.206	0.125	0.134	0.300
4	0.351	0.364	0.393	0.402	0.718	0.212	0.211	0.317	0.250	0.133	0.305	0.300
5	0.449	0.312	0.421	0.392	0.631	1.263	0.129	0.159	0.569	0.403	0.207	0.300
6	0.638	0.400	0.571	0.406	0.574	0.958	0.885	0.146	0.286	0.575	0.469	0.300
7	0.609	0.459	0.489	0.363	0.517	0.855	0.741	0.435	0.112	0.197	0.518	0.300
8	0.526	0.364	0.366	0.430	0.428	0.710	0.990	0.658	0.498	0.133	0.209	0.300
9	0.708	0.763	0.494	0.661	0.467	0.728	0.653	0.736	0.404	0.488	0.156	0.300
10	0.618	0.463	0.538	0.405	0.521	0.793	0.749	0.338	0.272	0.497	0.447	0.300
4+	0.445	0.365	0.428	0.403	0.608	0.860	0.401	0.304	0.450	0.415	0.341	0.300

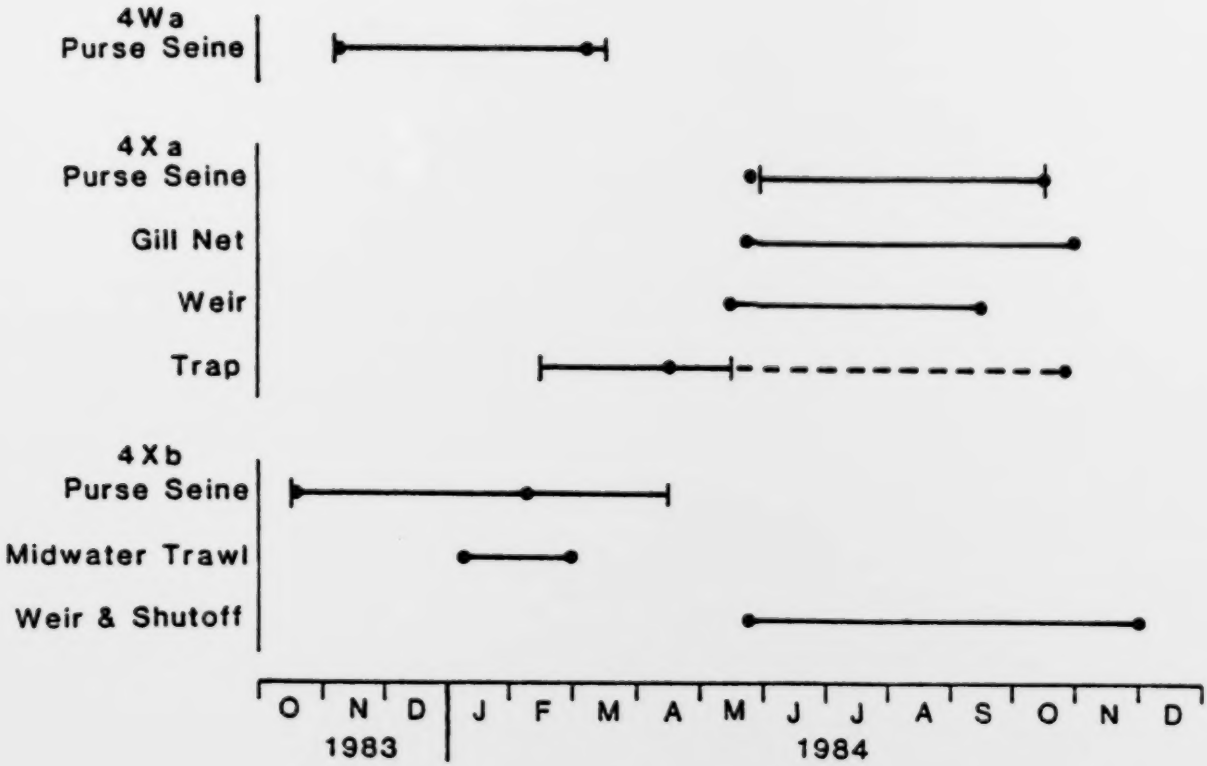


Fig. 1. Seasonal distributions of activity by gear component of the 4WX herring fishery. Dots (•) represent recorded limits of fishing activity, bars (—) represent limits of seasons.

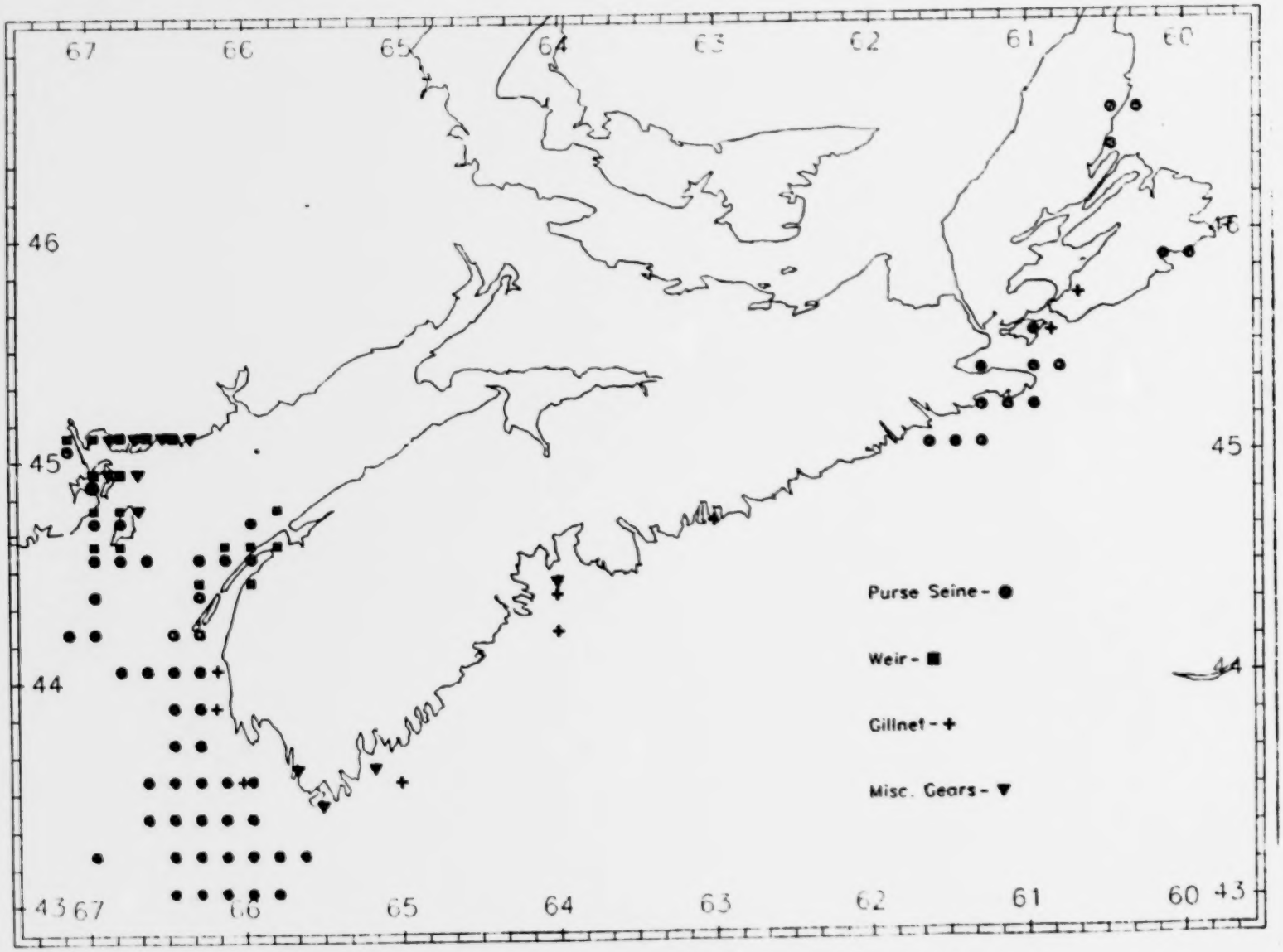


Fig. 2. Geographical distribution of gear components of the 1984 4WX (and 4Vn purse seine) herring fishery (resolution = 10' square).

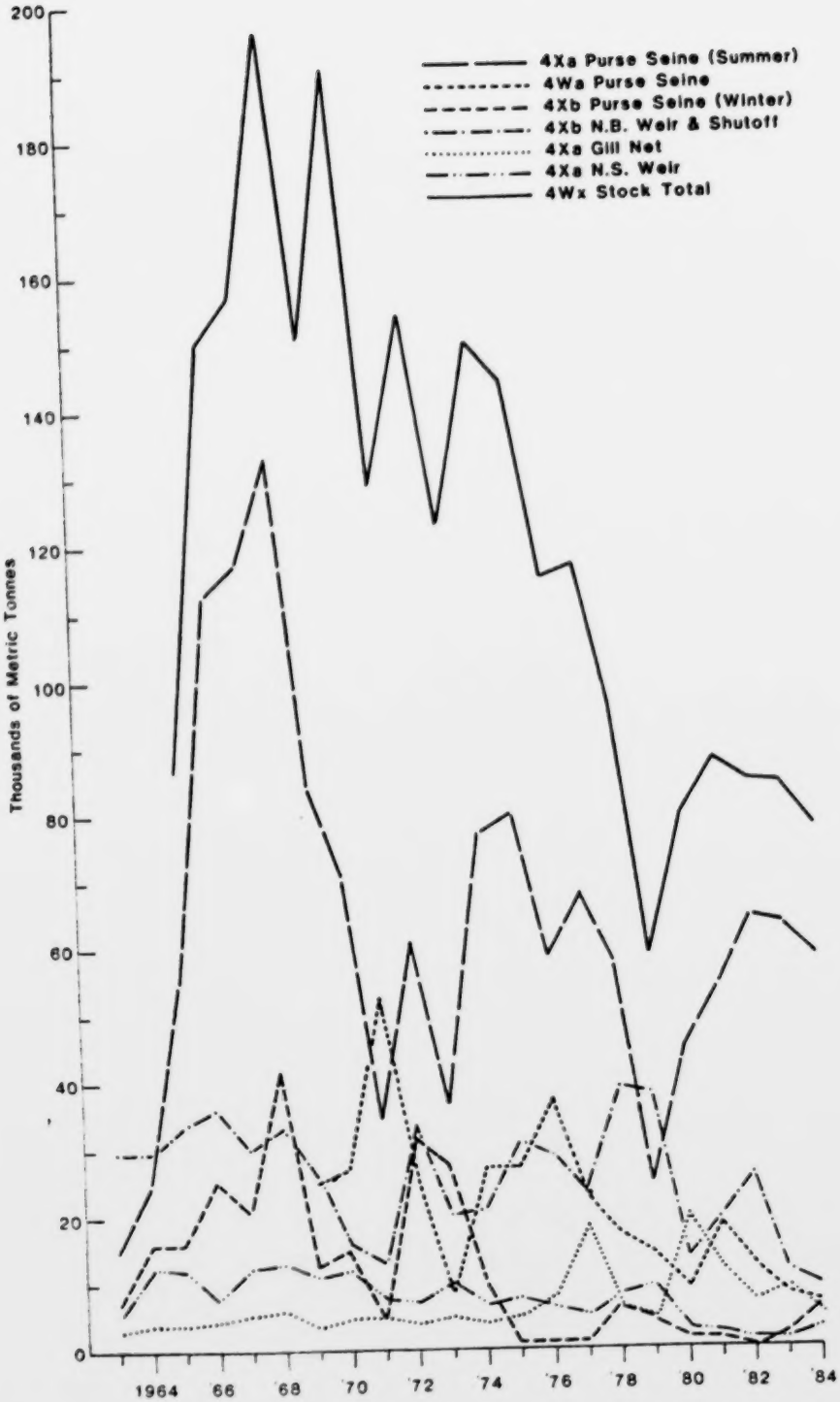


Fig. 3. Long-term (1963-present) landings by gear component of the 4WX herring fishery.

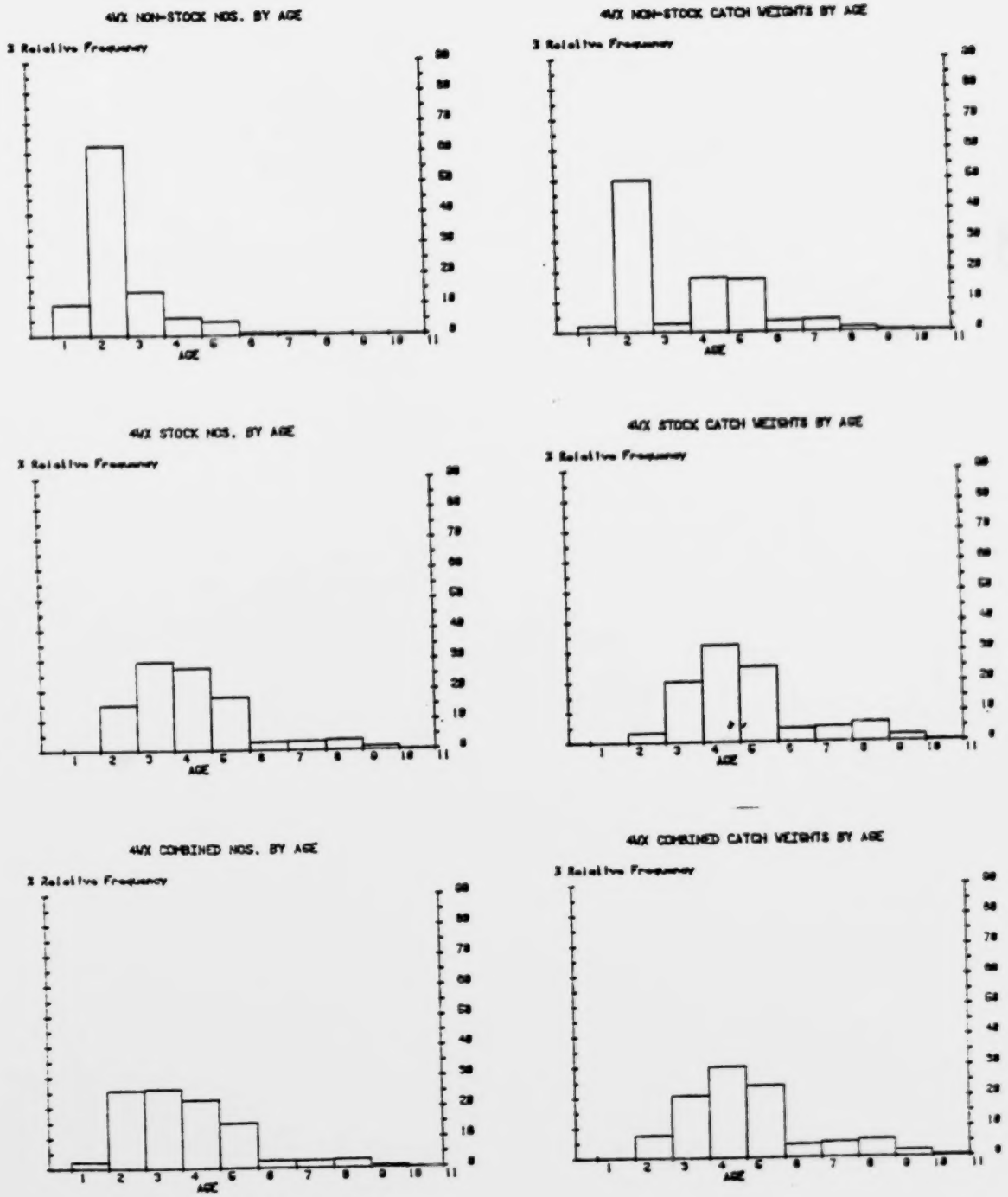
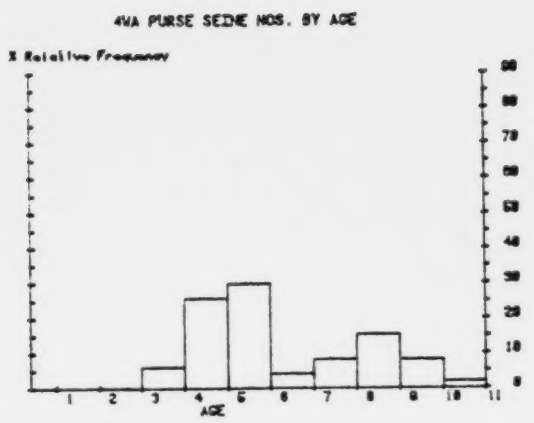
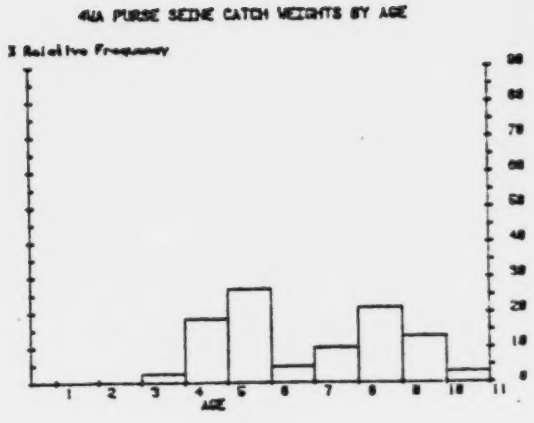
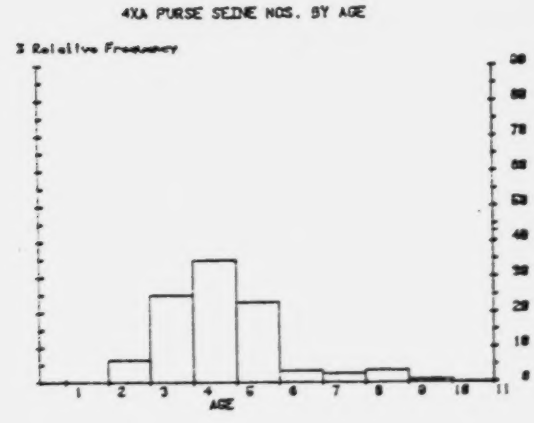
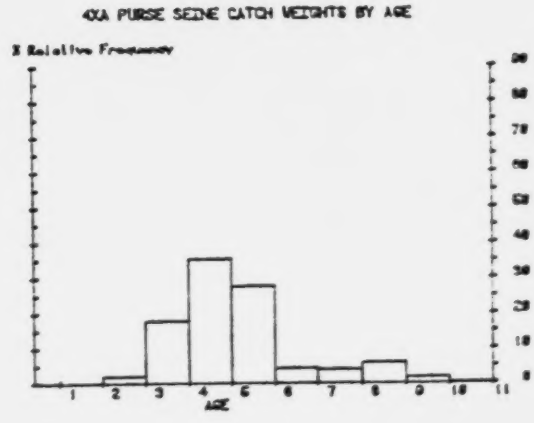


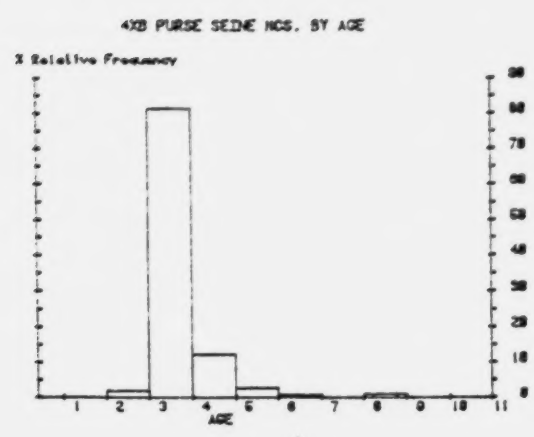
Fig. 4. Relative frequency (%) of numbers and weights by age in gear segments of the 1984 4WX herring fishery.











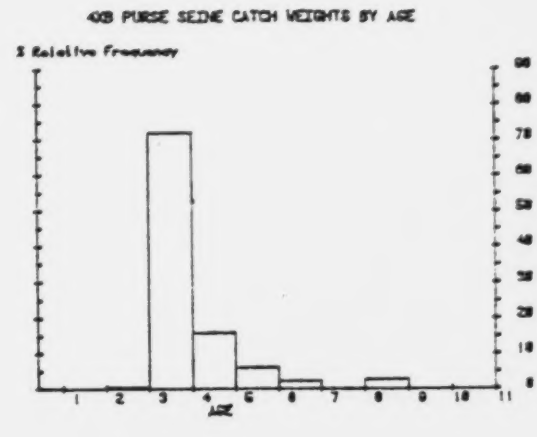
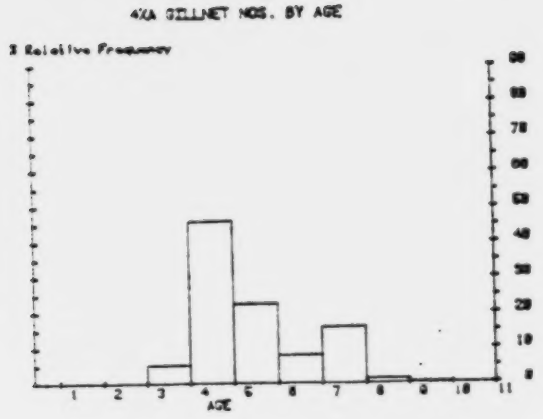
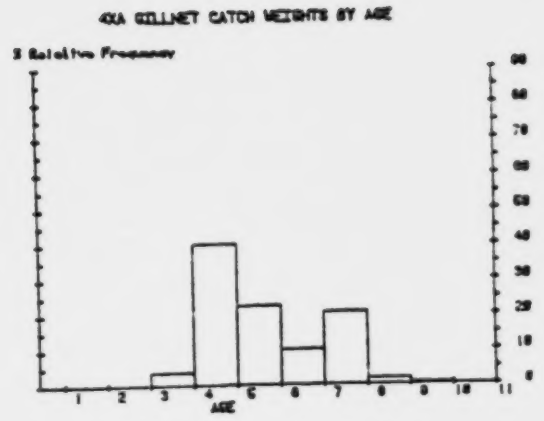
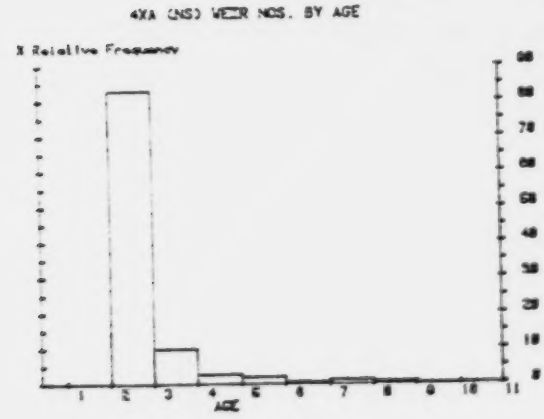
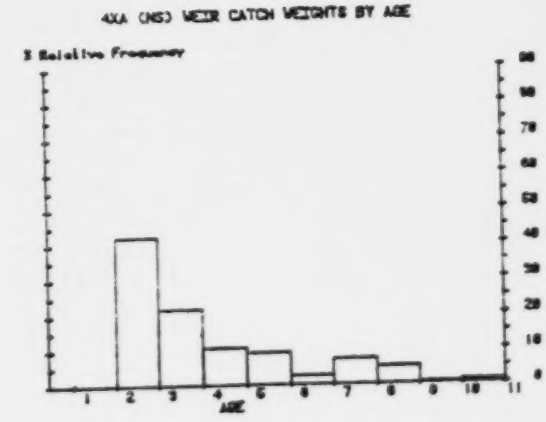


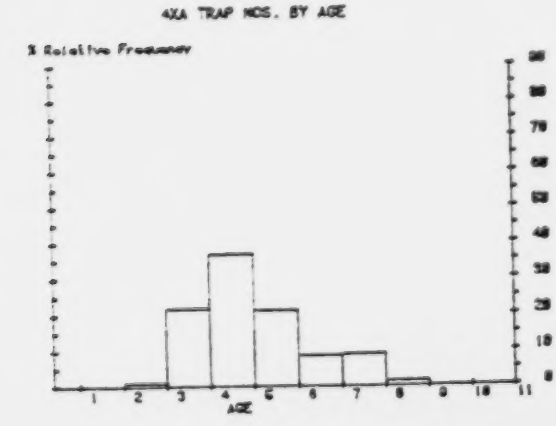
Fig. 4. Continued.

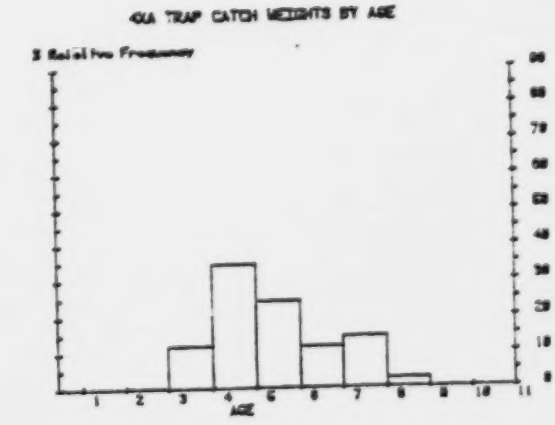












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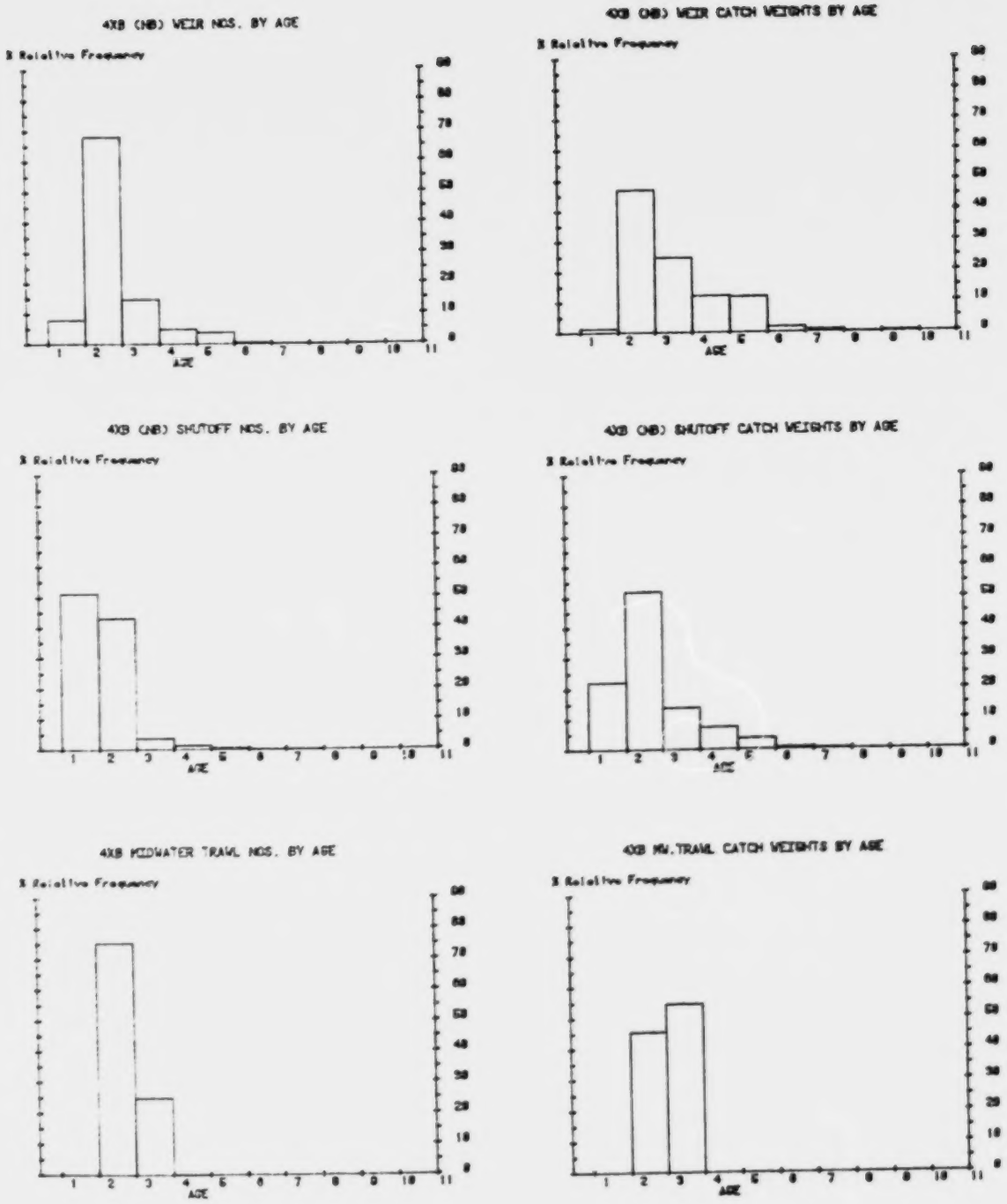
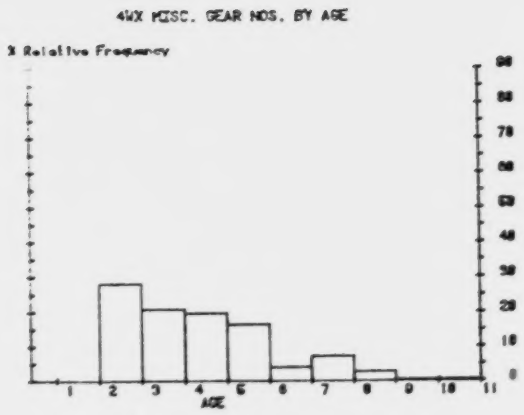


Fig. 4. Continued.



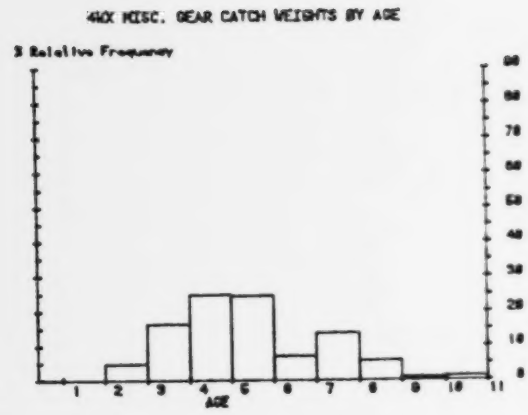


Fig. 4. Continued.

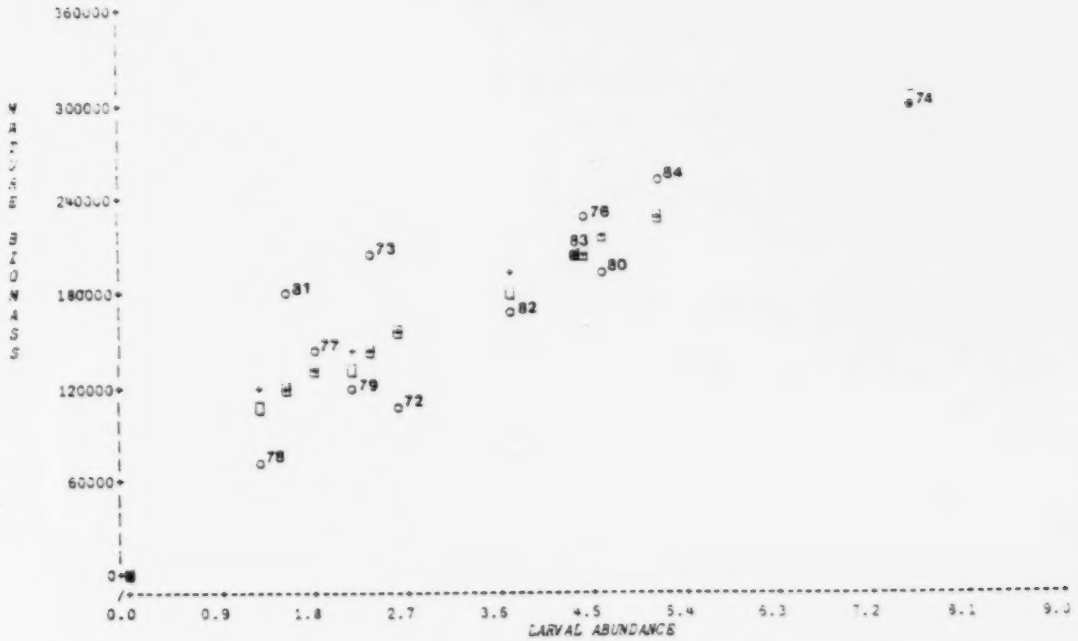


Fig. 5. 4WX herring "nominal" SPA estimated mature biomass vs. larval abundance; 1972-84.

APPENDIX 1

1984 HERRING MANAGEMENT PLAN

SCOTIA-FUNDY REGION

BASIC PRINCIPLES

1. Conservation and restoration of the fisheries resource.

2. Quotas to imply stock area and fleet segment.

3. Allocation of fishery resources will be on the basis of:

   (a) adjacency;

   (b) dependency on the fleet sector;

   (c) economic efficiency; and

   (d) fleet mobility.

4. Utilization of the fishery resources over the calendar year to the degree possible and among competing end product users so as to maximize the overall value of the resource.

5. All gear may be subject to quota management.

6. Access to herring stocks will be regulated by quotas and seasons.

PART I

HERRING PURSE SEINE

1. GENERAL

ALL PURSE SEINE VESSELS SHALL OPERATE ON AN ANNUAL VESSEL QUOTA AS DEFINED BELOW:

1. VESSEL QUOTA

Class A - 1.6% of purse seine quota, 1024 tonnes
Class B - 2.7% of purse seine quota, 1728 tonnes

These figures do not account for quota purchases. For those vessels with quota purchases the 1984 vessel quotas are as follows:

TOMMIE & ARNIE	-	2048
LISA ANNE	-	2048
SEAFOAM I	-	2560
LEROY & BARRY I	-	2560
MARGARET ELIZABETH	-	2560
JENNIFER JEAN I	-	2560
LADY MELISSA	-	2560
CPRD	-	1216

2. ALL Vessels which have purchased quotas must have demonstrated circulating chilling systems active prior to obtaining the 1984 purchased quota amount.

ALL VESSELS QUOTA WILL OCCUR THROUGH LICENSING

3. PARTICIPATION

Any Scotia-Fundy purse seine vessel may participate in any or all of the following herring fisheries: i.e., 4W, 4X (fall), 4X (brit), 4X (summer). The only restrictions will be area quota and overall vessel quota.

4. MONITORING

Government control of the TAC will occur through continual monitoring of all catches. This will include:

- accurate log records to be provided upon landing;
- all purchase slips, or copies, to be provided to DFO upon delivery;
- weighing of purse seine catches with associated weigh slips;

PART I CONT'D.

- special force.

II. PURSE SEINE FISHERIES

(A) Sydney Bight (4Vn)

(1) The season for purse seine vessels shall run from November 6, 1983, to March 16, 1984.

(2) The quota will be 5,000 tonnes, to be taken by Gulf-based purse seine vessels.

(3) The area of activity shall be north of a line drawn from Point Aconi in Cape Breton to the 3Pn Division intersect with the 4Vn line.

(4) The area east and south of the Point Aconi line in 4Vn shall not be fished by purse seine vessels.

(B) Chedabucto Bay (4W)

(1) The season for purse seine vessels shall run from November 7, 1983, to March 16, 1984.

(2) The quota will be 16,000 tonnes, to be taken by Scotia-Fundy vessels. Provision is made to increase this quota should vessels wish to continue operations provided that:

(a) markets are identified;
(b) the vessel has annual quota remaining; and
(c) the March 16 closure has not been reached.

(3) The following closure line will be in effect:

Waters of Chedabucto Bay in 4W lying west of a straight line extending from Cape Canso at 45° 18' north latitude, 60° 56' west longitude to Green Island at 45° 29' north latitude, 60° 54' west longitude.

(C) Bay of Fundy - Fall and "Brit" Fishery

(1) The fall and winter Bay of Fundy purse seine fisheries will be combined into one fishery with the following provisions:

(a) The season will be October 16, to April 15 of the next year.

(b) A total of 6,000 t will be assigned in the following manner:

(i) up to 4,000 t to be caught in the October 16 - December 31 portion of the fishery;

.../3

PART I CONT'D.

(ii) of the amount captured in (i) above, 50 percent will be assigned to the TAC up to a maximum of 2,000 to;

(iii) the "brit" fishery will comprise the second portion of the fall and winter Bay of Fundy purse seine fishery with January 1 - April 15 season;

(iv) the quota for the 1984 "brit" fishery will be 2,000 t for 1984;

(v) all catches will be deducted from individual vessel quotas for the 1984 season (50 percent of fall catch + 100 percent of the "brit" catch).

(2) The fishery will be closed when:

- quotas are reached;
- seasonal closures are reached; or
- irregularities in quality, size, end-product use or misreporting occurs.

(D) Bay of Fundy - Summer Fishery

(1) The season for purse seine vessels shall run from June 1, 1984 to October 15, 1984.

(2) The quota will be (64,000 - (X+Y+Z)), to be taken by Scotia-Fundy vessels.

X = 4W catch
Y = Fall 4X catch (50 percent)
Z = 4X Brit catch

(3) A 3,000 t quota will be assigned to the Scotts Bay area for purse seine vessels as part of the summer domestic (4X) purse seine quota.

(4) A Georges Bank purse seine fishery is authorized under the following conditions:

(a) fishing to occur in the Canadian Zone of 5Ze;

(b) a DFO observer must be present on all trips to facilitate this activity;

(c) 24 hour's notice must be given to DFO prior to departure; and

(d) failure to comply with parts, (a), (b) and (c) will result in any catch being assigned to that vessel's 4X quota.

PART II

SCOTIA-FUNDY INSHORE HERRING MANAGEMENT PLAN

1. All catch information shall be provided to the department for each catch.

2. All purchase slip information shall be provided for each purchase and shall include identification of amount purchase, fishermen and date of purchase.

3. Inshore effort in southern New Brunswick and in Nova Scotia east of Baccaro will not be under quota management.

4. Sourthern New Brunswick weirs will be assigned an allocation of anticipated catch.

5. No effort increases will occur in any inshore fishery.

6. All herring sold for bait will be recorded and applied against quotas.

WEIR FISHERY

The Nova Scotia weir fishery will have a 3,200 t quota.

HERRING SET NET FISHERY

1. A quota of 2,400 t for all set gill nets, excluding catches east of Baccaro and the sourthern New Brunswick shore.

2. After the season, all moorings must be removed from the water.

3. No increase in effort will be permitted.

HERRING DRIFT NET FISHERY

1. The herring drift net quota will be 9,500 t, exclusive of Grand Manan catches.

2. Licences for drift nets are limited to those holding same for 1983.

TRAP FISHERY

1. A 1,000 t quota is assigned to the Liverpool trap net fishery with a season of February 15 - May 15 for 1984. Catches after this date will not be under quota control.

2. All mackerel traps in the 4X area are limited to a 10% by-catch of herring up to a maximum of 100 t.

3. Herring traps located in areas outside of 4X west of Baccaro will not be controlled by assigned quota.

APPENDIX 2 - CATCH PROJECTIONS FOR 4WX HERRING

Three catch projections for 1985-90 were generated for each matrix using the following input data:

Age	Mean wt (kg)	Adjusted 1984 population		Nominal 1984 population	
		Number	Weight(t)	Number	Weight(t)
1	.010	1847768	16733	1576036	14257
2	.041	698733	22125	748315	24118
3	.112	1031603	107211	769603	82800
4	.172	950324	143139	716051	111652
5	.218	618836	111358	463288	86304
6	.254	96211	19621	74376	15700
7	.286	91722	20199	75303	17167
8	.323	119871	27940	88921	21456
9	.354	40305	9800	29558	7440
10	.389	9247	2649	6890	2043

a) Assumed the 1984 PR (age 1 = .002, 2 = .5, 3+ = 1), a 1985 catch of 107710 (100,000 t quota for purse seine plus the 1984 level of catch for other gear) and $F_{0.1}$ = .254 thereafter.

b) Assumed the 1984 PR (age 1 = .002, 2 = .5, 3+ = 1) and an $F_{0.1}$ level of fishing (= .254) in 1985 and subsequent years.

c) Assumed the previous (1983) PR pattern (age 1 = .02, 3 = .2, 3 = .53, 4+ = 1), a 1985 catch of 107710 quota and $F_{0.1}$ = .3 thereafter.

Results of these projections are listed in Tables A2-1 to A2-6 and summarized below:

Matrix Proj.	Quota/F				Projected catch biomass (t)			
	85	86	87	88	85	86	87	88
Adj. A	107,710	.254	.254	.254	107,710	100,000	103,000	108,000
Adj. B	.254	.254	.254	.254	99,000	102,000	105,000	109,000
Adj. C	107,710	.3	.3	.3	107,710	100,000	106,000	114,000
Nom. A	107,710	.254	.254	.254	107,710	82,000	86,000	91,000
Nom. B	.254	.254	.254	.254	84,000	87,000	90,000	94,000
Nom. C	107,710	.3	.3	.3	107,710	81,000	88,000	95,000

Based upon the assessment parameters listed and the expected catch of 107,710 t in 1985, the catch resulting from fishing at $F_{0.1}$ = .254 in 1986 is 100,000 t (adjusted) or 82,000 t (nominal). The $F_{0.1}$ catch for 1985 is calculated as 99,000 t for the adjusted matrix and 84,000 t for the nominal matrix. The expected catch in 1985 (107,710 t) will result in a fully recruited F of .28 in the adjusted case and .34 in the nominal case.

Table A2-1. 4WX herring catch projection Adjusted Matrix "A".
Assumptions: PR for age 1 = .002, 2 = .5, 3+ = 1
1985 catch = 107 710 t
1986+ catch at $F_{0.1}$ = .254

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1847768	1846300	1846300	1846300	1846300
2	698733	1512824	1510781	1510855	1510855
3	1031603	492389	1077651	1089400	1089453
4	950324	625699	305174	684398	691859
5	618836	576401	387796	193810	434649
6	96221	375343	357242	246283	123086
7	91722	58361	232630	226878	156410
8	119871	55632	36171	147740	144087
9	40305	72706	34480	22972	93827
10	9247	24446	45062	21898	14589
1+	5504630	5640100	5833287	5990533	6105114
2+	3656862	3793800	3986987	4144233	4258814
3+	2958129	2280976	2476206	2633378	2747959
4+	1926526	1788587	1398555	1543978	1658506

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	9	8	8	8
2	3626	7322	6710	6710	6710
3	27277	12202	24642	24910	24911
4	38589	23812	10716	24033	24295
5	31849	27803	17260	8626	19345
6	5770	21094	18525	12771	6383
7	6193	3693	13583	13247	9133
8	9141	3976	2385	9743	9502
9	3368	5695	2492	1660	6781
10	849	2104	3579	1739	1159
1+	126661	107710	99901	103449	108227
2+	126661	107701	99892	103440	108219
3+	123036	100379	93182	96730	101508
4+	95759	88177	68541	71820	76597

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.001	0.001	0.001	0.001
2	0.150	0.139	0.127	0.127	0.127
3	0.300	0.278	0.254	0.254	0.254
4	0.300	0.278	0.254	0.254	0.254
5	0.300	0.278	0.254	0.254	0.254
6	0.300	0.278	0.254	0.254	0.254
7	0.300	0.278	0.254	0.254	0.254
8	0.300	0.278	0.254	0.254	0.254
9	0.300	0.278	0.254	0.254	0.254
10	0.300	0.278	0.254	0.254	0.254
1+	0.180	0.150	0.141	0.144	0.146

Table A2-2. 4WX herring catch projection Adjusted Matrix "B".
Assumptions: PR for age 1 = .002, 2 = .5, 3+ = 1
1985+ catch at $F_{0.1}$ = .254

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1847768	1846300	1846300	1846300	1846300
2	698733	1512824	1510855	1510855	1510855
3	1031603	492389	1090873	1089453	1089453
4	950324	625699	312708	692795	691893
5	618836	576401	397370	198595	439982
6	96221	375343	366062	252363	126124
7	91722	58361	238374	232480	160271
8	119871	55632	37064	151387	147644
9	40305	72706	35331	23539	96143
10	9247	24446	46174	22438	14949
1+	5504630	5640100	5881111	6020204	6123614
2+	3656862	3793800	4034811	4173904	4277314
3+	2958129	2280976	2523956	2663050	2766460
4+	1926526	1788587	1433083	1573597	1677007

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	8	8	8	8
2	3626	6719	6710	6710	6710
3	27277	11259	24944	24911	24911
4	38589	21972	10981	24328	24296
5	31849	25654	17686	8839	19582
6	5770	19464	18983	13087	6540
7	6193	3408	13919	13574	9358
8	9141	3669	2444	9983	9736
9	3368	5255	2553	1701	6949
10	849	1941	3667	1782	1187
1+	126661	99349	101896	104924	109279
2+	126661	99340	101887	104916	109271
3+	123036	92621	95177	98206	102561
4+	95759	81362	70233	73294	77649

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.001	0.001	0.001	0.001
2	0.150	0.127	0.127	0.127	0.127
3	0.300	0.254	0.254	0.254	0.254
4	0.300	0.254	0.254	0.254	0.254
5	0.300	0.254	0.254	0.254	0.254
6	0.300	0.254	0.254	0.254	0.254
7	0.300	0.254	0.254	0.254	0.254
8	0.300	0.254	0.254	0.254	0.254
9	0.300	0.254	0.254	0.254	0.254
10	0.300	0.254	0.254	0.254	0.254
1+	0.180	0.137	0.142	0.144	0.146

Table A2-3. 4WX herring catch projections Adjusted Matrix "C".
Assumptions: PR for age 1 = .01, 2 = .22, 3 = .53, 4+ = 1
1985 catch = 107 710
1986+ catch at $F_{0.1}$ = .3

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1847768	1846300	1846300	1846300	1846300
2	698733	1512824	1506965	1507095	1507095
3	1031603	492389	1157294	1154997	1155096
4	950324	625699	342307	808224	806620
5	618836	576401	376253	207620	490213
6	96221	375343	346608	228209	125928
7	91722	58361	225706	210229	138416
8	119871	55632	35094	136897	127510
9	40305	72706	33453	21286	83032
10	9247	24446	43720	20291	12910
1+	5504630	5640100	5913700	6141146	6293120
2+	3656862	3793800	4067400	4294846	4446820
3+	2958129	2280976	2560435	2787752	2939725
4+	1926526	1788587	1403141	1632755	1784629

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	52	50	50	50
2	3626	3694	3581	3581	3581
3	27277	7562	17315	17281	17283
4	38589	26033	13900	32819	32754
5	31849	30396	19364	10685	25229
6	5770	23062	20784	13684	7551
7	6193	4038	15240	14194	9346
8	9141	4347	2676	10439	9723
9	3368	6226	2796	1779	6939
10	849	2300	4015	1863	1186
1+	126661	107710	99721	106376	113641
2+	126661	107658	99671	106326	113591
3+	123036	103964	96090	102745	110010
4+	95759	96402	78775	85464	92728

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.003	0.003	0.003	0.003
2	0.150	0.068	0.066	0.066	0.066
3	0.300	0.164	0.159	0.159	0.159
4	0.300	0.309	0.300	0.300	0.300
5	0.300	0.309	0.300	0.300	0.300
6	0.300	0.309	0.300	0.300	0.300
7	0.300	0.309	0.300	0.300	0.300
8	0.300	0.309	0.300	0.300	0.300
9	0.300	0.309	0.300	0.300	0.300
10	0.300	0.309	0.300	0.300	0.300
1+	0.180	0.131	0.120	0.127	0.131

Table A2-4. 4WX herring catch projection Nominal Matrix "A".
Assumptions: PR for age 1 = .002, 2 = .5, 3+ = 1
1985 catch = 107 710 t
1986+ catch at $F_{0.1}$ = .254

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1576036	1575210	1575210	1575210	1575210
2	748315	1290349	1288805	1289018	1289018
3	769603	547479	892757	929336	929490
4	716051	503143	320095	566975	590205
5	463288	468133	294173	203287	360076
6	74376	302884	273703	186824	129104
7	75303	48625	177087	173824	118649
8	88921	49231	28429	112465	110393
9	29558	58134	28784	18055	71425
10	6890	19324	33989	18280	11466
1+	4548343	4862512	4913033	5073274	5185036
2+	2972307	3287302	3337823	3498064	3609826
3+	2223992	1996953	2049018	2209046	2320808
4+	1454388	1449474	1156261	1279710	1391318

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	10	7	7	7
2	2964	7450	5724	5725	5725
3	15800	15977	20414	21250	21254
4	22575	22549	11240	19910	20725
5	18513	26591	13093	9048	16026
6	3463	20046	14193	9688	6695
7	3948	3624	10340	10150	6928
8	5265	4143	1875	7416	7280
9	1918	5362	2080	1305	5162
10	491	1959	2699	1452	911
1+	74936	107710	81666	85951	90713
2+	74936	107700	81659	85943	90705
3+	71972	100250	75935	80218	84980
4+	56172	84273	55521	58968	63727

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.001	0.001	0.001	0.001
2	0.112	0.168	0.127	0.127	0.127
3	0.225	0.337	0.254	0.254	0.254
4	0.225	0.337	0.254	0.254	0.254
5	0.225	0.337	0.254	0.254	0.254
6	0.225	0.337	0.254	0.254	0.254
7	0.225	0.337	0.254	0.254	0.254
8	0.225	0.337	0.254	0.254	0.254
9	0.225	0.337	0.254	0.254	0.254
10	0.225	0.337	0.254	0.254	0.254
1+	0.129	0.183	0.139	0.143	0.145

Table A2-5. 4WX herring catch projection Nominal matrix "B".
Assumptions: PR for age 1 = .002, 2 = .5, 3+ = 1
1985+ catch $F_{0.1}$ = .254

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1576036	1575210	1575210	1575210	1575210
2	748315	1290349	1289018	1289018	1289018
3	769603	547479	930450	929490	929490
4	716051	503143	347695	590912	590303
5	463288	468133	319538	220815	375278
6	74376	302884	297303	202933	140236
7	75303	48625	192356	188812	128879
8	88921	49231	30881	122162	119911
9	29558	58134	31266	19612	77583
10	6890	19324	36920	19856	12455
1+	4548343	4862512	5050635	5158820	5238363
2+	2972307	3287302	3475425	3583610	3663153
3+	2223992	1996953	2186407	2294592	2374135
4+	1454388	1449474	1255958	1365103	1444646

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	7	7	7	7
2	2964	5731	5725	5725	5725
3	15800	12519	21276	21254	21254
4	22575	17668	12210	20750	20729
5	18513	20835	14222	9828	16703
6	3463	15707	15417	10523	7272
7	3948	2839	11232	11025	7525
8	5265	3246	2036	8056	7907
9	1918	4201	2260	1417	5607
10	491	1535	2932	1577	989
1+	74936	84289	87316	90162	93719
2+	74936	84281	87309	90155	93711
3+	71972	78551	81584	84430	87986
4+	56172	66032	60308	63176	66733

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.001	0.001	0.001	0.001
2	0.112	0.127	0.127	0.127	0.127
3	0.225	0.254	0.254	0.254	0.254
4	0.225	0.254	0.254	0.254	0.254
5	0.225	0.254	0.254	0.254	0.254
6	0.225	0.254	0.254	0.254	0.254
7	0.225	0.254	0.254	0.254	0.254
8	0.225	0.254	0.254	0.254	0.254
9	0.225	0.254	0.254	0.254	0.254
10	0.225	0.254	0.254	0.254	0.254
1+	0.129	0.138	0.143	0.145	0.147

Table A2-6. 4WX herring catch projection Nominal Matrix "C".
Assumptions: PR for age 1 = .01, 2 = .22, 3 = .53, 4+ = 1
1985 catch = 107 710
1986+ catch at $F_{0.1}$ = .3

POPULATION NUMBERS 25/ 9/85

	1984	1985	1986	1987	1988
1	1576036	1575210	1575210	1575210	1575210
2	748315	1290349	1284761	1285810	1285810
3	769603	547479	971383	984691	985495
4	716051	503143	366166	678389	687683
5	463288	468133	281265	222091	411464
6	74376	302884	261693	170596	134705
7	75303	46625	169317	158725	103472
8	88921	49231	27182	102696	96272
9	29558	58134	27521	16487	62288
10	6890	19324	32498	16692	10000
1+	4548343	4862512	4996996	5211387	5352397
2+	2972307	3287302	3421786	3636177	3777187
3+	2223992	1996953	2137025	2350367	2491378
4+	1454388	1449474	1165642	1365676	1505883

CATCH BIOMASS 25/ 9/85

	1984	1985	1986	1987	1988
1	0	54	43	43	43
2	2964	3866	3053	3055	3055
3	15800	10210	14534	14733	14745
4	22575	25039	14869	27547	27924
5	18513	29527	14476	11430	21176
6	3463	22259	15692	10230	8078
7	3948	4024	11432	10717	6986
8	5265	4601	2073	7831	7341
9	1918	5954	2300	1378	5206
10	491	2175	2984	1533	918
1+	74936	107710	81455	88496	95472
2+	74936	107656	81412	88453	95429
3+	71972	103789	78360	85398	92374
4+	56172	93579	63826	70665	77629

FISHING MORTALITY 25/ 9/85

	1984	1985	1986	1987	1988
1	0.000	0.004	0.003	0.003	0.003
2	0.113	0.084	0.066	0.066	0.066
3	0.225	0.202	0.159	0.159	0.159
4	0.225	0.382	0.300	0.300	0.300
5	0.225	0.382	0.300	0.300	0.300
6	0.225	0.382	0.300	0.300	0.300
7	0.225	0.382	0.300	0.300	0.300
8	0.225	0.382	0.300	0.300	0.300
9	0.225	0.382	0.300	0.300	0.300
10	0.225	0.382	0.300	0.300	0.300
1+	0.129	0.160	0.119	0.126	0.130

P R O P O S A L

As a result of the consultation conducted to date, April 1 - 2, 1985, the following package was developed.

1. A purse seine quota for 1985 of 100,000 tonnes. For other gear types, there will be an allowance. It should be noted that the biological advice for 1985 is a total of 85,000 tonnes.

2. Over-the-side sales recommendations:

   a. for the purse seine component an 8,000 t OSS linked with an over-the-wharf sale of 8,000 t round weight equivalent. This program is to be managed by Fundy Coordinators;

   b. for the gillnet component a 2,500 t OSS linked with an over-the-wharf sale of 1,500 t round weight equivalent. This program will be managed by the MFU;

   c. a cooperation arrangement will occur between the two management groups (MFU & Fundy Coordinators) to ensure daily OSS capacity is filled; and

   d. for the weir component a 1,000 t OSS program. This is to be managed by Fundy Coordinators.

3. There will be a closure to purse seiners on Trinity Ledge covering period last week in August - first week in September.

4. Carcasses

   Every encouragement will be made in 1985 to move carcasses to meal plants; attempts will be made to develop food use for carcasses and every level of local government will be contacted to discourage dumping on land. No dumping, at sea, will be permitted.

5. Roe Fishery

   No special efforts will be made to segregate the roe and food fisheries.

6. For future trade missions on herring, representatives of the Scotia-Fundy herring processing and fishing industries should be chosen by the 4WX Herring Management Committee.

7. Monitoring - There are several components:

   a. One central marketing office (presumably Fundy Coordinators) to which all landings will be reported, by the captain, on a daily basis;

   b. One DFO employee will work with the industry coordinator on a continuing basis;

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c. A verbal hail including port of landing must be provided to DFO via the central marketing office nightly:

d. Each skipper/owner authorizes the central marketing agency to notify: fellow members of his cumulative seasonal landings.

d. Each skipper/owner agrees to provide, in writing, a release to processors to provide accurate sales slip information to DFO; and

f. Fragmented licensing will continue for 1985.

In the interim, we will be pursuing regulation amendments providing for compulsory reporting prior to landing and authority to designate ports of landings.